US008050817B2

(12) **United States Patent**
Moinzadeh et al.

(10) **Patent No.: US 8,050,817 B2**
(45) **Date of Patent: Nov. 1, 2011**

(54) **CENTRALIZED MANAGEMENT OF MOTOR VEHICLE SOFTWARE APPLICATIONS AND SERVICES**

(75) Inventors: **Kamyar Moinzadeh**, Bellevue, WA (US); **Leon L. Hong**, Sammamish, WA (US); **Lee Zhao**, Sammamish, WA (US)

(73) Assignee: **Airbiquity Inc.**, Seattle, WA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/914,871**

(22) Filed: **Oct. 28, 2010**

(65) **Prior Publication Data**

US 2011/0093137 A1 Apr. 21, 2011

Related U.S. Application Data

(63) Continuation of application No. 12/777,989, filed on May 11, 2010, which is a continuation-in-part of application No. 12/729,207, filed on Mar. 22, 2010.

(60) Provisional application No. 61/252,066, filed on Oct. 15, 2009, provisional application No. 61/260,781, filed on Nov. 12, 2009.

(51) **Int. Cl.**

G06F 7/00	(2006.01)
H04W 24/00	(2009.01)
G06F 17/30	(2006.01)

(52) **U.S. Cl.** **701/36**; 701/2; 701/24; 701/25; 701/49; 701/200; 701/207; 340/5.1; 340/5.8; 340/5.81; 340/995.1; 340/438; 455/456.1; 455/456.2; 455/456.3; 455/457; 709/217; 709/219; 709/220; 709/229; 726/26; 726/27; 726/28; 726/29; 726/30

(58) **Field of Classification Search** 340/5.1, 340/5.8, 5.81, 905, 936, 995.1, 995.11, 995.12, 340/995.13, 995.27, 438, 439, 441, 466, 340/576; 455/456.1, 456.2, 456.3, 457, 569.1, 455/569.2, 575.9; 701/1, 2, 23–26, 29, 30, 701/32, 33, 35, 36, 48, 49, 200, 208–213, 701/300; 709/203, 208, 209, 211, 217–220, 709/229; 707/705, 732; 726/2–4, 26–30; 348/211.3

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,898,910 A 4/1999 Miyake

(Continued)

FOREIGN PATENT DOCUMENTS

CA 2242494 9/1997

(Continued)

OTHER PUBLICATIONS

Global Patent Solutions LLC, "Search Report" for Search Name: Centralized Management of Motor Vehicle Software Applications and Services, Jul. 30, 2010.

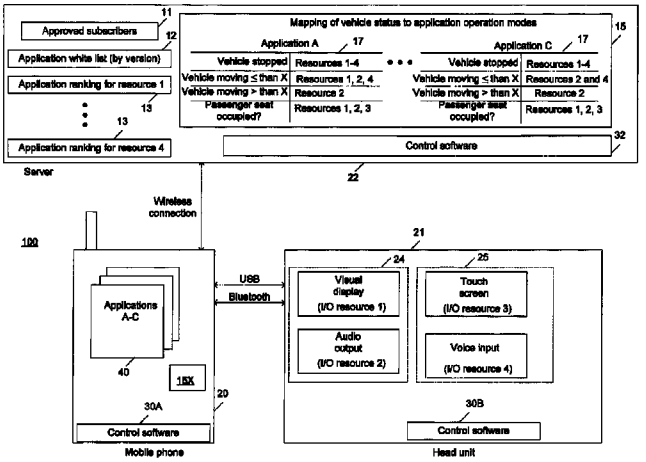
(Continued)

Primary Examiner — John Nguyen
Assistant Examiner — Chuong Nguyen
(74) *Attorney, Agent, or Firm* — Stolowitz Ford Cowger LLP

(57) **ABSTRACT**

In one example, a network device stores a mapping of application operation modes to vehicle conditions such as a first condition of the vehicle powered but not moving and a second condition of the vehicle moving. The network device receives a wirelessly transmitted request for a particular application to utilize an interface powered by the vehicle. The network device compares an application identifier specified by the received request to the mapping. The network device then identifies a portion of the vehicle interface according to the comparison and signals control software on the vehicle to grant the particular application access to only the identified portion of the vehicle interface itself. The application can reside on the mobile device and utilize the vehicle interface as an extended interface, or the application can reside on the vehicle.

18 Claims, 15 Drawing Sheets



U.S. PATENT DOCUMENTS

6,105,063	A	8/2000	Hayes, Jr.	
6,148,253	A	11/2000	Taguchi et al.	
6,175,789	B1	1/2001	Beckert et al.	
6,356,812	B1	3/2002	Cragun	
6,434,450	B1	8/2002	Griffin, Jr. et al.	
6,487,717	B1	11/2002	Brunemann et al.	
6,553,375	B1	4/2003	Huang et al.	
6,650,534	B2	11/2003	Tree	
6,799,201	B1	9/2004	Lee et al.	
6,812,942	B2 *	11/2004	Ribak	345/30
6,853,910	B1	2/2005	Oesterling	
6,961,536	B2	11/2005	Himmel	
6,973,476	B1	12/2005	Naden et al.	
6,981,022	B2	12/2005	Boundy	
7,053,866	B1	5/2006	Mimran	
7,062,528	B2	6/2006	Deguchi	
7,107,234	B2	9/2006	Deguchi	
7,127,454	B2	10/2006	Deguchi	
7,139,660	B2	11/2006	Sarkar et al.	
7,190,798	B2	3/2007	Yasuhara	
7,206,574	B2	4/2007	Bright	
7,218,925	B2	5/2007	Crocker	
7,251,473	B2	7/2007	Alrabady	
7,346,435	B2	3/2008	Amendola	
7,362,239	B2	4/2008	Franczyk et al.	
7,363,357	B2	4/2008	Parupudi et al.	
7,366,892	B2	4/2008	Spaur	
7,379,541	B2	5/2008	Iggulden et al.	
7,403,769	B2	7/2008	Kopra	
7,437,183	B2	10/2008	Makinen	
7,461,122	B2	12/2008	Kawana	
7,467,028	B2	12/2008	Pilgrim	
7,505,732	B2	3/2009	McDonough	
7,613,564	B2	11/2009	Vorona	
7,634,095	B2	12/2009	Arun	
7,643,788	B2	1/2010	Habaguchi et al.	
7,643,913	B2	1/2010	Taki et al.	
7,657,368	B2	2/2010	Weiss et al.	
7,676,830	B2	3/2010	Kuz	
7,684,908	B1	3/2010	Ogilvie et al.	
7,805,542	B2	9/2010	Hindman	
7,812,712	B2	10/2010	White	
7,815,100	B2	10/2010	Adams	
7,826,945	B2	11/2010	Zhang	
7,885,599	B2	2/2011	Yuhara	
2002/0087655	A1	7/2002	Bridgman et al.	
2003/0147534	A1 *	8/2003	Ablay et al.	380/270
2003/0195925	A1	10/2003	Kaneko et al.	
2004/0019416	A1	1/2004	Chen et al.	
2004/0259545	A1 *	12/2004	Morita	455/435.1
2005/0085965	A1	4/2005	Issa et al.	
2005/0132024	A1	6/2005	Habaguchi et al.	
2005/0193087	A1	9/2005	Swindells et al.	
2005/0216553	A1	9/2005	Mallonee	
2005/0216902	A1	9/2005	Schaefer	
2005/0221878	A1	10/2005	Van Bosch	
2005/0283284	A1	12/2005	Grenier et al.	
2006/0015221	A1 *	1/2006	Sarkar et al.	701/2
2006/0025907	A9	2/2006	Kapolka	
2006/0036356	A1	2/2006	Rasin et al.	
2006/0141962	A1	6/2006	Forbes	
2006/0156298	A1	7/2006	Min et al.	
2006/0161312	A1 *	7/2006	Juengling et al.	701/1
2006/0253874	A1	11/2006	Stark	
2006/0293813	A1	12/2006	Nou	
2006/0294514	A1	12/2006	Bauchot et al.	
2007/0005206	A1	1/2007	Zhang et al.	
2007/0021885	A1	1/2007	Soehren	
2007/0100513	A1	5/2007	Asano	
2007/0126604	A1	6/2007	Thacher	
2007/0143798	A1	6/2007	Jira et al.	
2007/0265744	A1	11/2007	Nicolai	
2008/0005733	A1	1/2008	Ramachandran	
2008/0007120	A1	1/2008	Weyl et al.	
2008/0071882	A1 *	3/2008	Hering et al.	709/217
2008/0248742	A1	10/2008	Bauer	
2008/0266051	A1	10/2008	Taki et al.	
2008/0269961	A1	10/2008	Shitanaka et al.	
2009/0079555	A1	3/2009	Aguirre De Carcer et al.	
2009/0119657	A1	5/2009	Link, II	
2009/0128286	A1	5/2009	Vitito	
2009/0138942	A1 *	5/2009	Alrabady et al.	726/4
2009/0204815	A1 *	8/2009	Dennis et al.	713/168
2009/0215466	A1	8/2009	Ahl et al.	
2009/0265173	A1	10/2009	Madhavan	
2009/0265633	A1	10/2009	Lim	
2009/0265701	A1	10/2009	Naslavsky	
2009/0300595	A1	12/2009	Moran	
2010/0037057	A1	2/2010	Shim et al.	
2010/0082559	A1	4/2010	Sumcad et al.	
2010/0088367	A1	4/2010	Brown	
2010/0115505	A1	5/2010	Touati	
2010/0125387	A1	5/2010	Sehyun et al.	
2010/0153207	A1	6/2010	Roberts et al.	
2010/0222939	A1	9/2010	Namburu et al.	

FOREIGN PATENT DOCUMENTS

DE	102 26 425	A1	12/2003
DE	10 2005 044943	A1	3/2006
EP	0 978 433	A2	2/2000
EP	1125784		8/2001
EP	1205883	B1	6/2008
EP	2012090	A2	1/2009
WO	WO 02/19116	A2	3/2002
WO	WO 03/034235	A1	4/2003
WO	WO 2005/105509	A1	11/2005
WO	2006023713		3/2006
WO	2007/057895	A2	5/2007
WO	2008/055117	A2	5/2008
WO	2008050136		5/2008
WO	2008124795		10/2008
WO	2009/016917	A1	2/2009

OTHER PUBLICATIONS

UTC, "Vehicle Console Personalization" Aug. 10, 2006.

UTC, "Hybrid Vehicular Display" Aug. 24, 2004.

Global Patent Solutions LLC, "Additional Search Results" for Search Name: Centralized Management of Motor Vehicle Software Applications and Services, Dec. 27, 2010.

Global Patent Solutions LLC, "Additional Search Results" dated Feb. 5, 2011.

Global Patent Solutions LLC, "Additional Search Results" dated Feb. 10, 2011.

Stolowitz Ford Cowger LLP, Listing of Related Cases, Mar. 21, 2011.

"3rd Generation Partnership Project; Technical Specification Group Services and System Aspects Push Architecture (Release 6); 3GPP TR 23.976," ETSI Standards; v. 3-SA2, No. V6 1.0; pp. 1-34, Jun. 1, 2004.

Supplementary European Search Report based on EP 06 71 9988 completed Jun. 13, 2008.

United States Patent and Trademark Office ISA; PCT International Search Report; PCT/US2008/056323; Jun. 30, 2008; 2 pages.

Ryu et al,: "The Design of Remote Vehicle Management System Based on OMA DM Protocol and AUTOSAR S/W Architecture;" Jul. 23-25, 2008.

International Search Report dated Dec. 15, 2010 for PCT/US10/52515.

International Search Report dated Feb. 10, 2011 for PCT/US2010/052493.

International Search Report dated Feb. 10, 2011 for PCT/US2010/052502.

Stolowitz Ford Cowger LLP—List of Related Cases; Apr. 5, 2011.

Visteon Corporation; "Visteon Helps Connect Drivers and Passengers to Their Vehicles . . . and Their Vehicles to the World"; Jan. 7, 2010; http://www.prnewswire.com/news-releases/visteon-helps-connect-drivers-and-passengers-to-their-vehicles-and-their-vehicles-to-the-world-80902587.html.

Marisetty et al.; "An Architecture for In-Vehicle Infotainment Systems"; Jan. 29, 2010; http://www.drdobbs.com/embedded-systems/222600438.

Ryu et al.; "The Design of Remote vehicle Management System Based on OMA DM Protocol and AUTOSAR S/W Architecture"; Jul. 23-25, 2008.
Nilsson et al.; "Secure firmware updates over the air in intelligent vehicles"; May 19-23, 2008.
IBM; "Mobile Device used as an External Graphical User Interface for Telematics Hardware installed in a Car. Demonstrating Speeding control and Road User Charge"; Oct. 13, 2005.
Alpine Electronics of America, Inc.; "Alpine Launches Mobile Phone Solution That Integrates With Car Audio Head Units"; Dec. 23, 2009.
"Mobile Device used as an External Graphical User Interface for Telematics Hardware installed in a Car. Demonstrating Speeding control and Road User Charge;" Disclosed by IBM; UTC; Oct. 13, 2005; 2 pages.

* cited by examiner

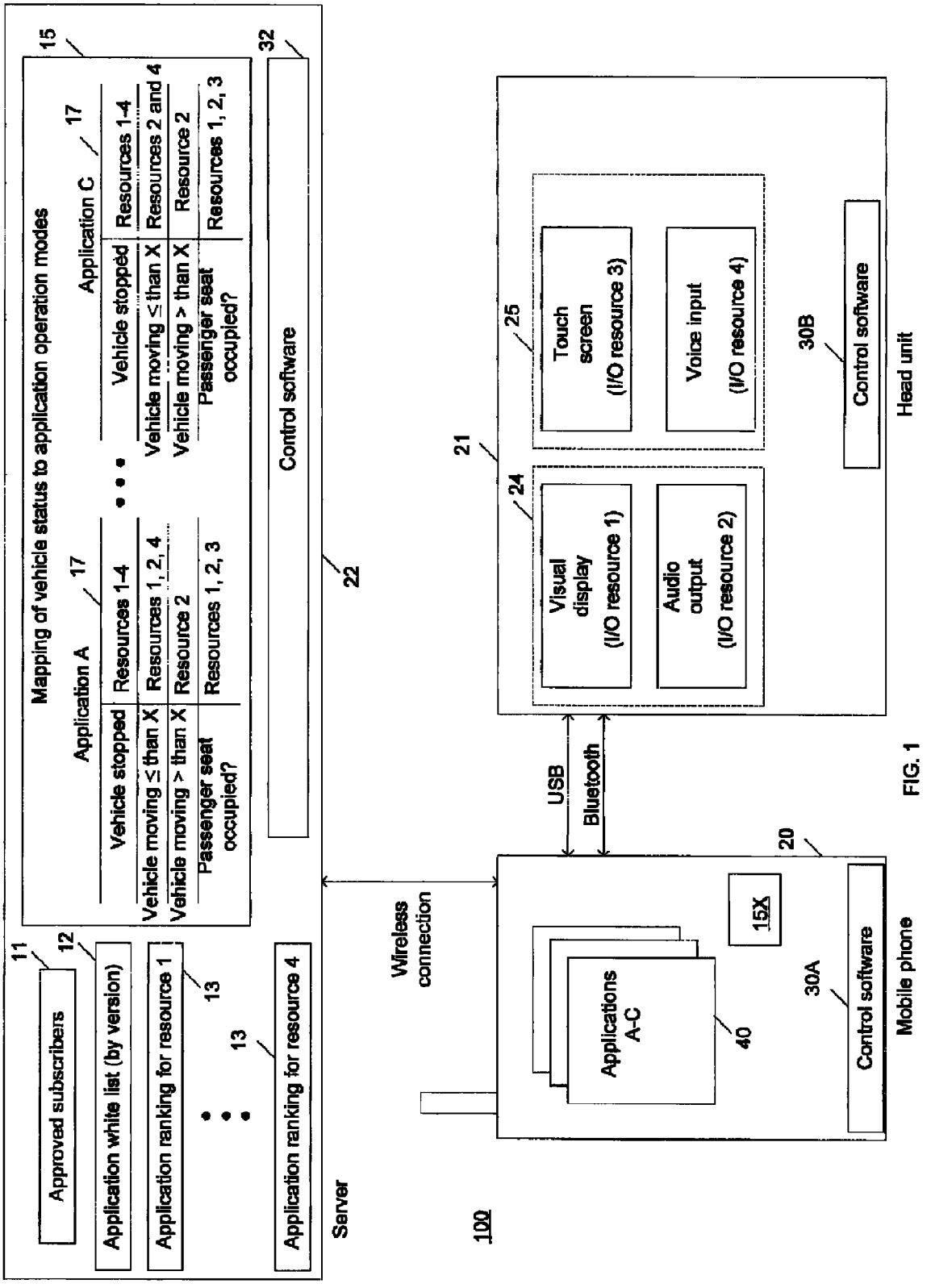

100
Server
11
Approved subscribers
12
Application white list (by version)
Application ranking for resource 1
13
13
Application ranking for resource 4
Mapping of vehicle status to application operation modes
15
Application A
17
Application C
17
Vehicle stopped
Resources 1-4
Vehicle stopped
Resources 1-4
Vehicle moving ≤ than X
Resources 1, 2, 4
Vehicle moving ≤ than X
Resources 2 and 4
Vehicle moving > than X
Resource 2
Vehicle moving > than X
Resource 2
Passenger seat occupied?
Resources 1, 2, 3
Passenger seat occupied?
Resources 1, 2, 3
Control software
32
22
Wireless connection
USB
Bluetooth
Mobile phone
20
Applications A-C
40
15X
30A
Control software
21
24
Visual display (I/O resource 1)
Audio output (I/O resource 2)
25
Touch screen (I/O resource 3)
Voice input (I/O resource 4)
30B
Control software
Head unit

FIG. 1

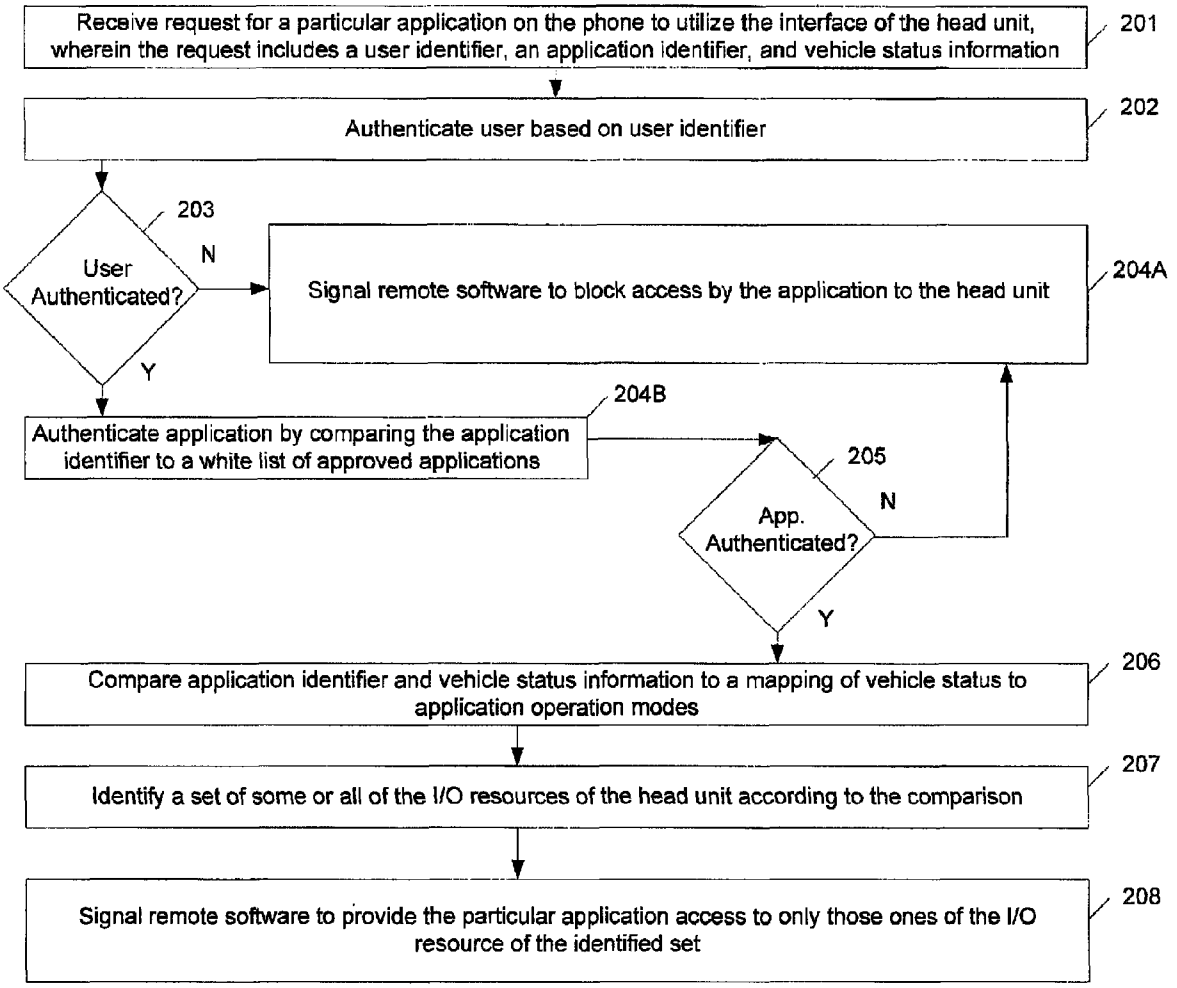

Receive request for a particular application on the phone to utilize the interface of the head unit, wherein the request includes a user identifier, an application identifier, and vehicle status information
201
Authenticate user based on user identifier
202
203
User Authenticated?
N
Y
Signal remote software to block access by the application to the head unit
204A
204B
Authenticate application by comparing the application identifier to a white list of approved applications
205
App. Authenticated?
N
Y
Compare application identifier and vehicle status information to a mapping of vehicle status to application operation modes
206
Identify a set of some or all of the I/O resources of the head unit according to the comparison
207
Signal remote software to provide the particular application access to only those ones of the I/O resource of the identified set
208

FIG. 2A

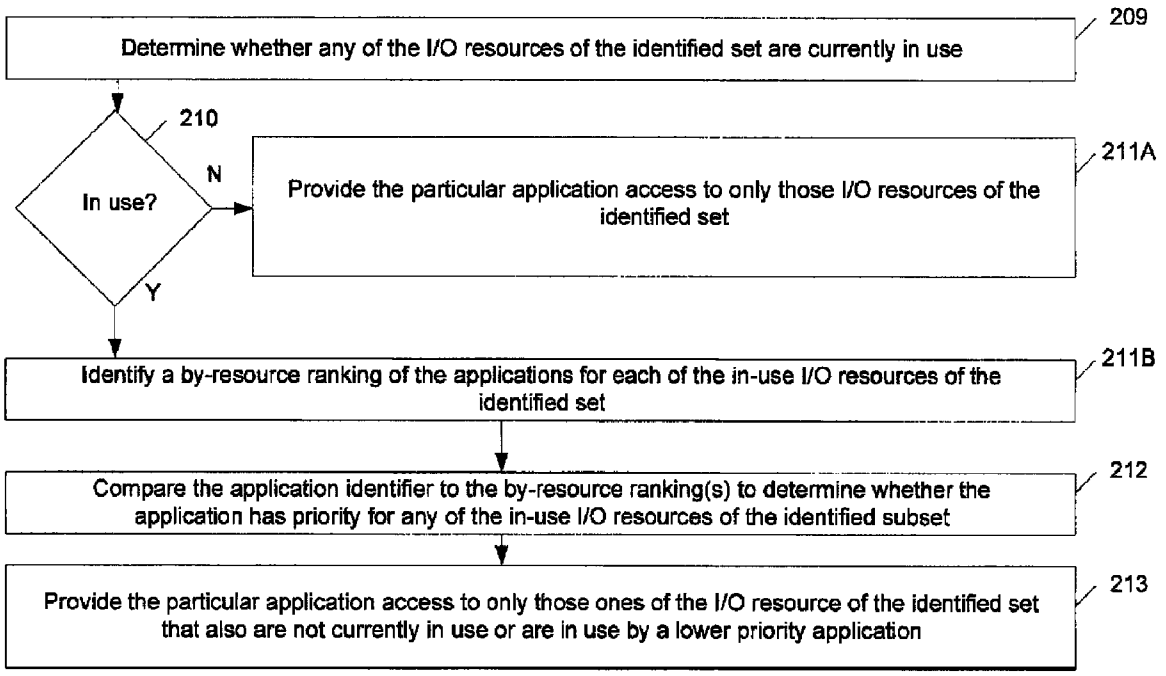

Determine whether any of the I/O resources of the identified set are currently in use
209
210
In use?
N
Y
Provide the particular application access to only those I/O resources of the identified set
211A
Identify a by-resource ranking of the applications for each of the in-use I/O resources of the identified set
211B
Compare the application identifier to the by-resource ranking(s) to determine whether the application has priority for any of the in-use I/O resources of the identified subset
212
Provide the particular application access to only those ones of the I/O resource of the identified set that also are not currently in use or are in use by a lower priority application
213

FIG. 2B

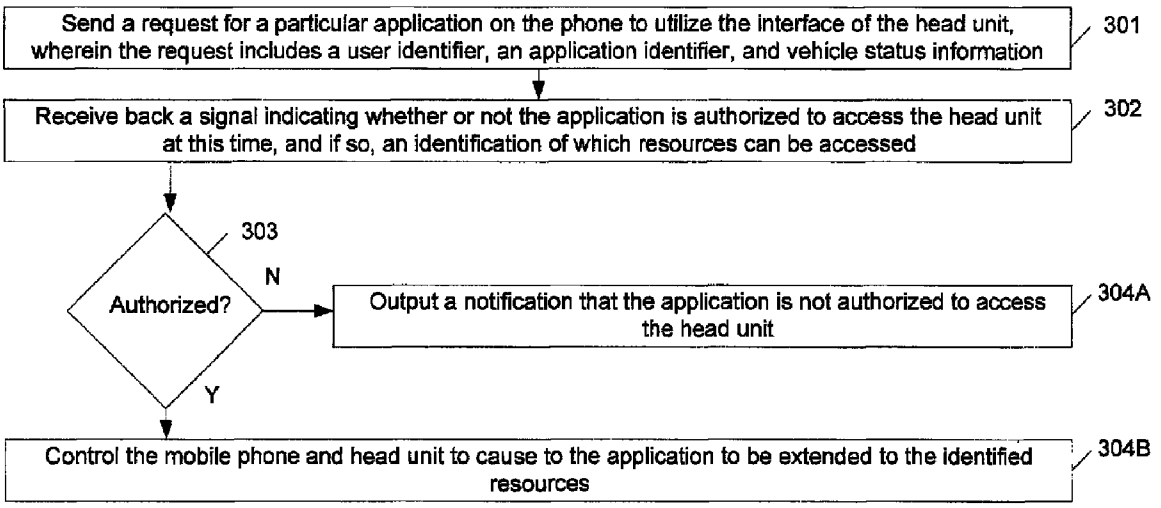

Send a request for a particular application on the phone to utilize the interface of the head unit, wherein the request includes a user identifier, an application identifier, and vehicle status information
301
Receive back a signal indicating whether or not the application is authorized to access the head unit at this time, and if so, an identification of which resources can be accessed
302
303
Authorized?
N
Output a notification that the application is not authorized to access the head unit
304A
Y
Control the mobile phone and head unit to cause to the application to be extended to the identified resources
304B

FIG. 3

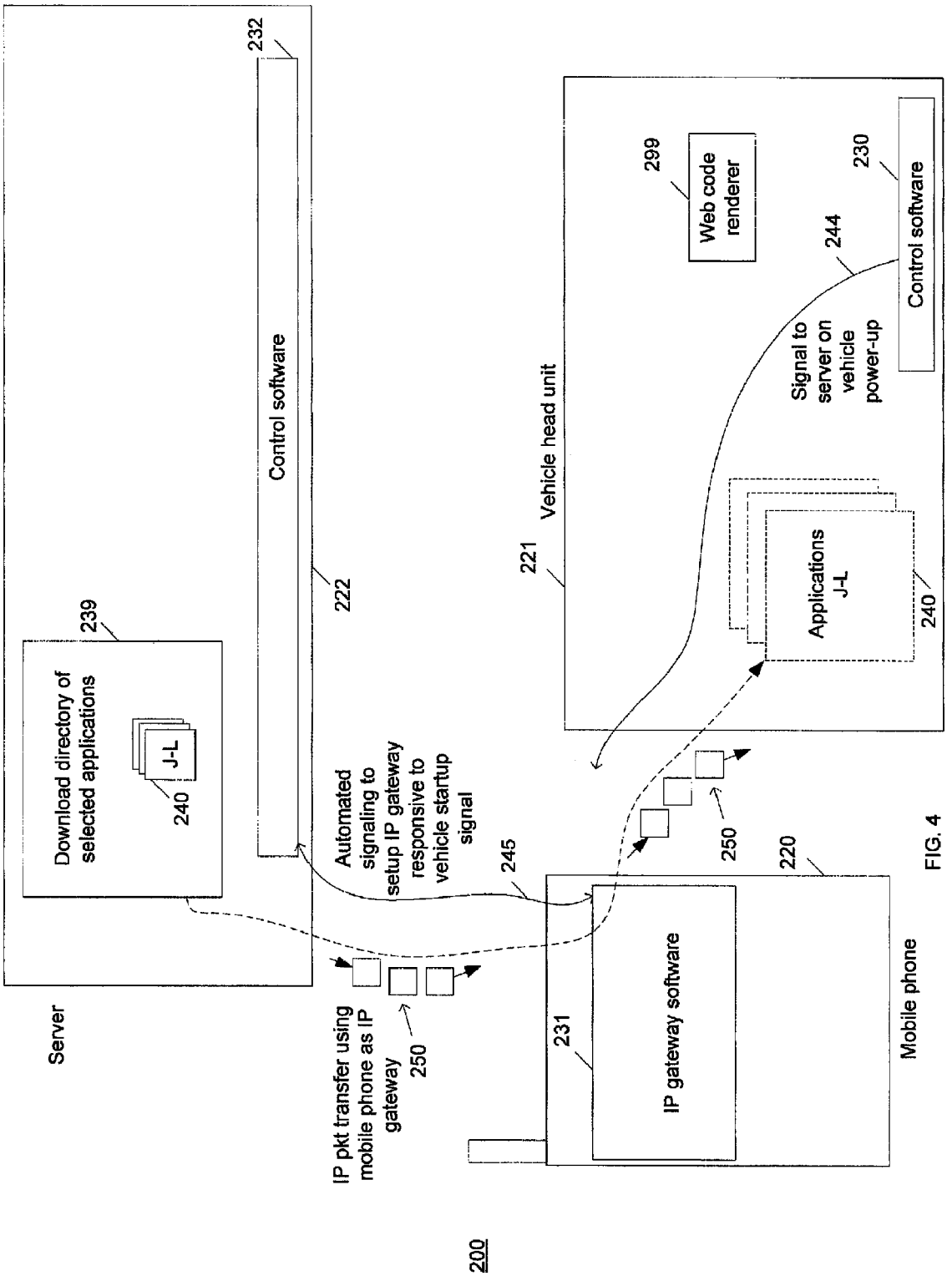

Server
232
Control software
222
239
Download directory of selected applications
J-L
240
Automated signaling to setup IP gateway responsive to vehicle startup signal
245
IP pkt transfer using mobile phone as IP gateway
250
231
IP gateway software
220
Mobile phone
250
221
Vehicle head unit
299
Web code renderer
230
Control software
244
Signal to server on vehicle power-up
Applications J-L
240
200

FIG. 4

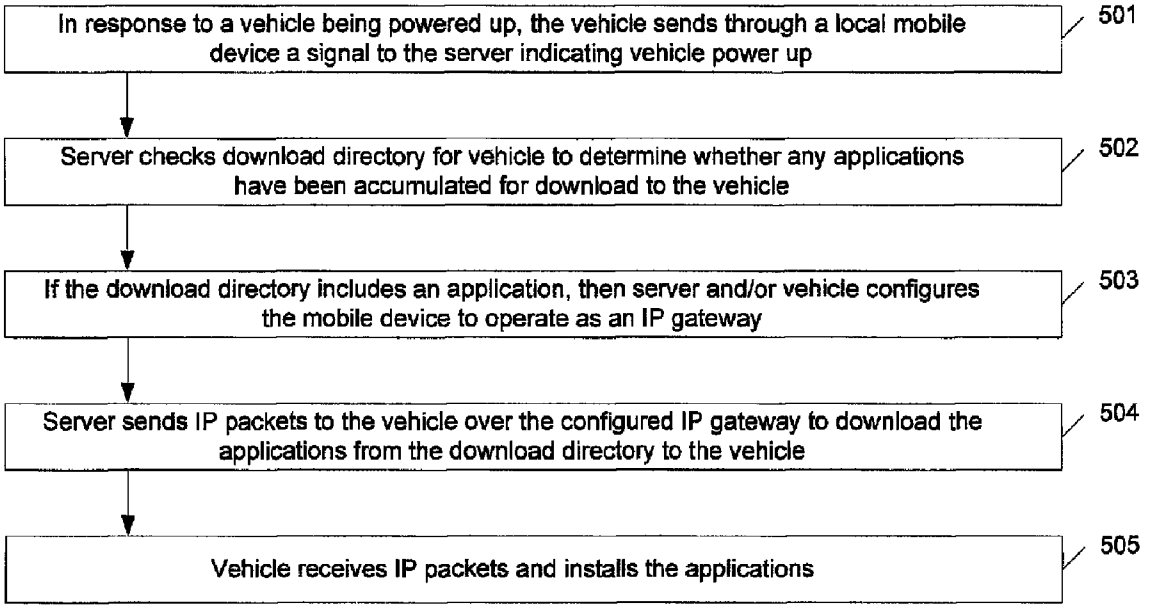

In response to a vehicle being powered up, the vehicle sends through a local mobile device a signal to the server indicating vehicle power up
501
Server checks download directory for vehicle to determine whether any applications have been accumulated for download to the vehicle
502
If the download directory includes an application, then server and/or vehicle configures the mobile device to operate as an IP gateway
503
Server sends IP packets to the vehicle over the configured IP gateway to download the applications from the download directory to the vehicle
504
Vehicle receives IP packets and installs the applications
505

FIG. 5

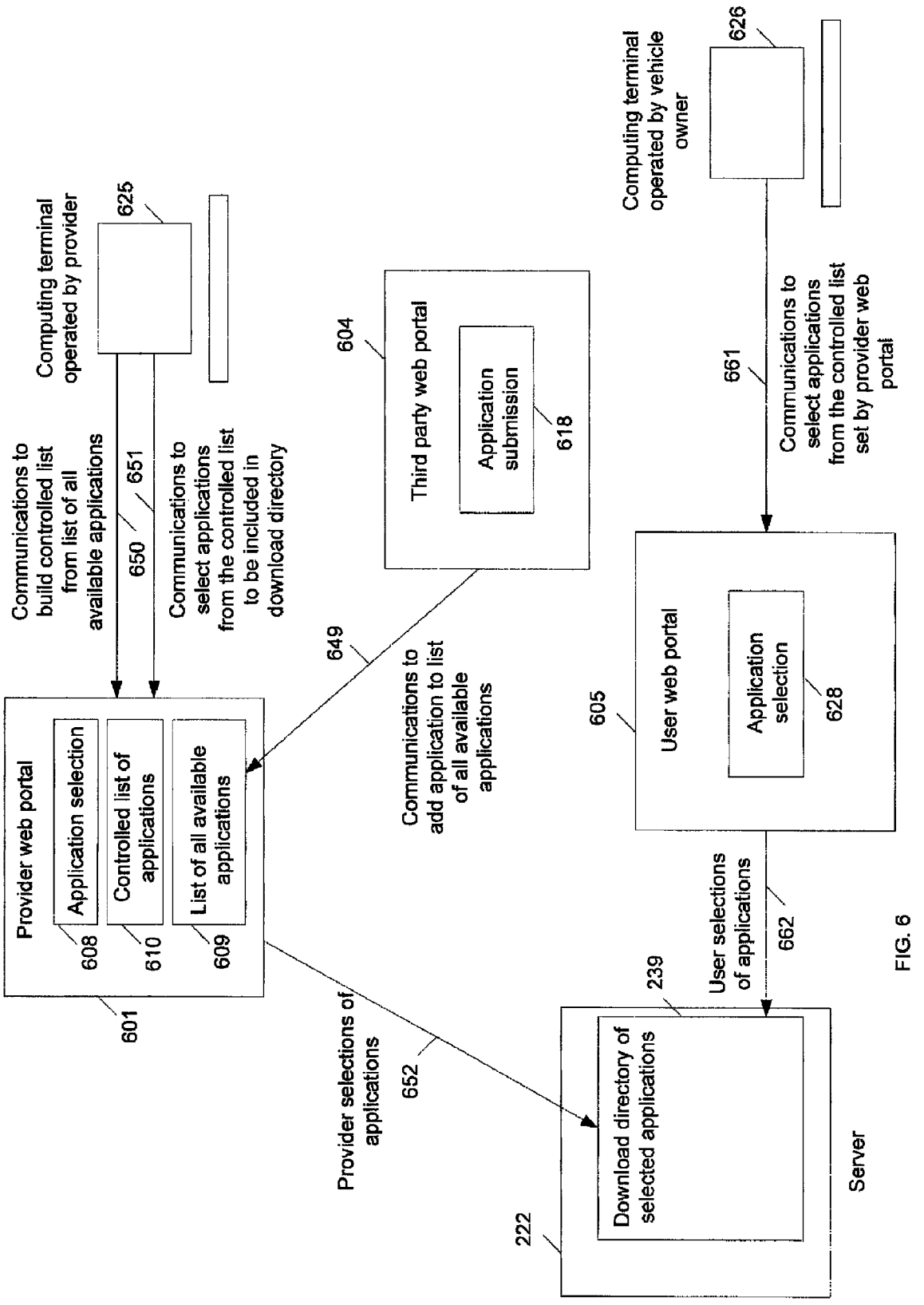

Computing terminal operated by provider
625
Computing terminal operated by vehicle owner
626
Communications to build controlled list from list of all available applications
650
Communications to select applications from the controlled list to be included in download directory
651
Third party web portal
604
Application submission
618
Communications to add application to list of all available applications
649
Communications to select applications from the controlled list set by provider web portal
661
Provider web portal
601
Application selection
608
Controlled list of applications
610
List of all available applications
609
User web portal
605
Application selection
628
Provider selections of applications
652
User selections of applications
662
Server
222
Download directory of selected applications
239

FIG. 6

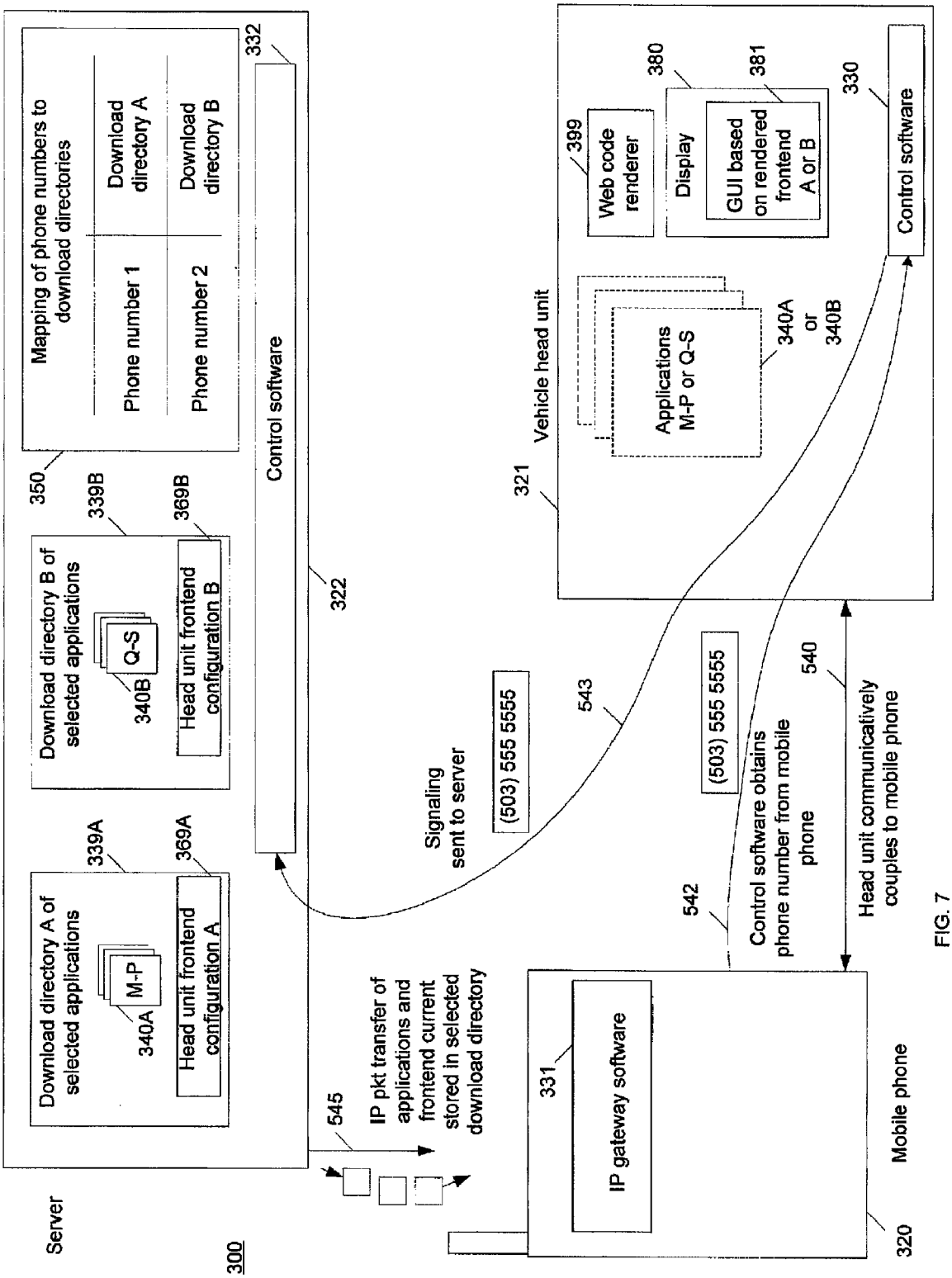

Server
300
Download directory A of selected applications
339A
M-P
340A
Head unit frontend configuration A
369A
Download directory B of selected applications
339B
Q-S
340B
Head unit frontend configuration B
369B
Mapping of phone numbers to download directories
350
Phone number 1
Download directory A
Phone number 2
Download directory B
Control software
332
322
545
IP pkt transfer of applications and frontend current stored in selected download directory
Signaling sent to server
(503) 555 5555
543
IP gateway software
331
Mobile phone
320
542
Control software obtains phone number from mobile phone
(503) 555 5555
540
Head unit communicatively couples to mobile phone
Vehicle head unit
321
Applications M-P or Q-S
340A or 340B
Web code renderer
399
Display
380
GUI based on rendered frontend A or B
381
Control software
330

FIG. 7

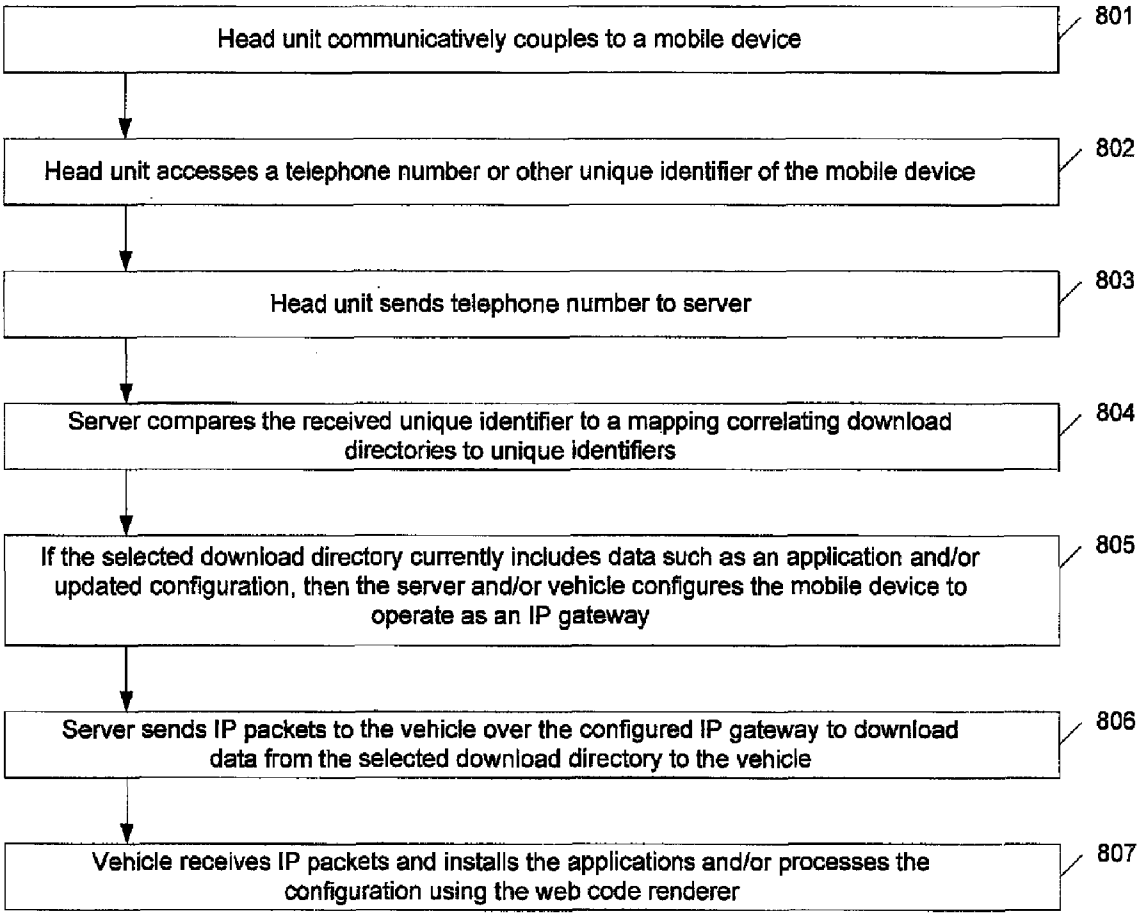

Head unit communicatively couples to a mobile device
801
Head unit accesses a telephone number or other unique identifier of the mobile device
802
Head unit sends telephone number to server
803
Server compares the received unique identifier to a mapping correlating download directories to unique identifiers
804
If the selected download directory currently includes data such as an application and/or updated configuration, then the server and/or vehicle configures the mobile device to operate as an IP gateway
805
Server sends IP packets to the vehicle over the configured IP gateway to download data from the selected download directory to the vehicle
806
Vehicle receives IP packets and installs the applications and/or processes the configuration using the web code renderer
807

FIG. 8

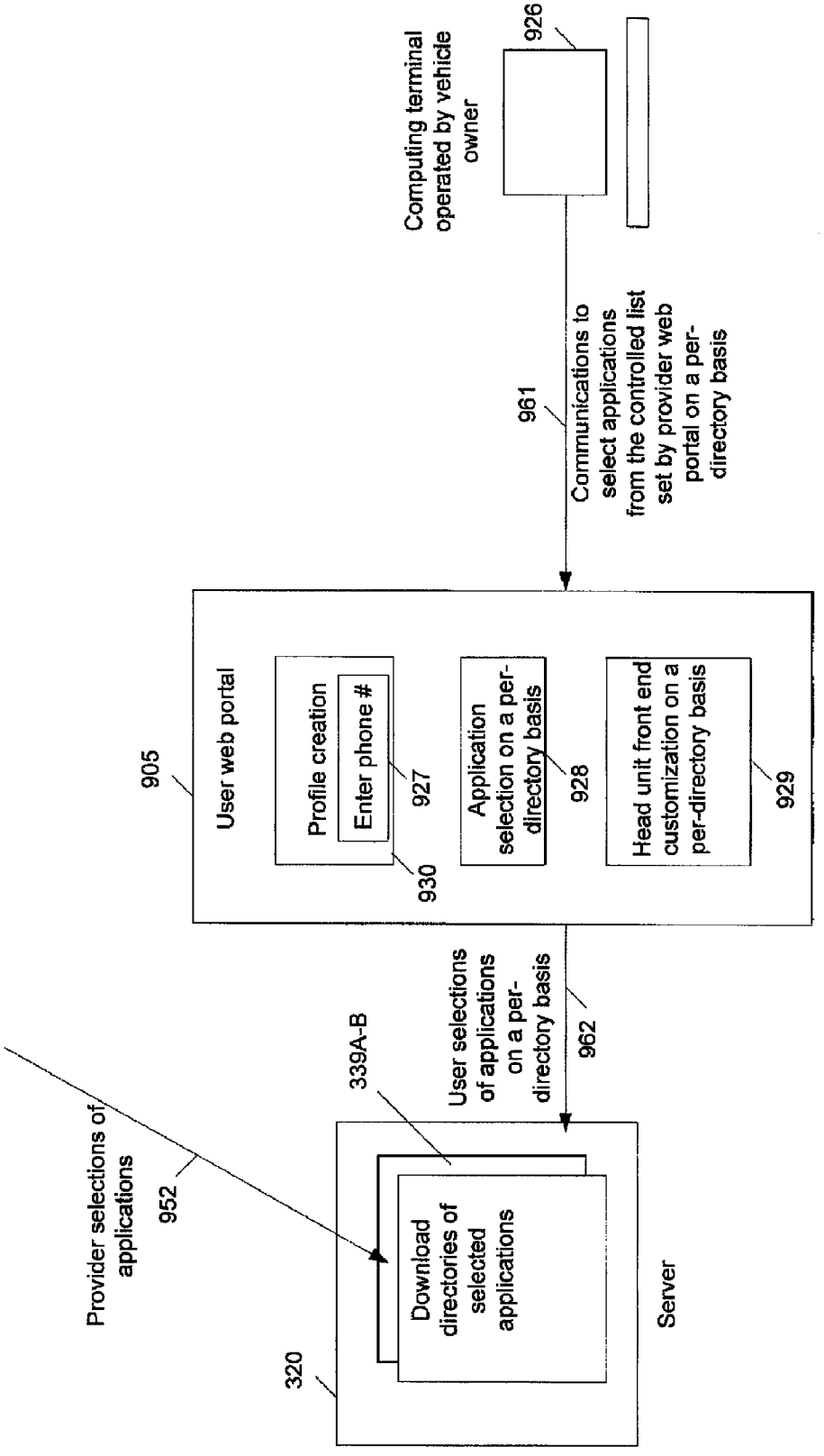

Computing terminal operated by vehicle owner
926
961
Communications to select applications from the controlled list set by provider web portal on a per-directory basis
905
User web portal
Profile creation
Enter phone #
927
930
Application selection on a per-directory basis
928
Head unit front end customization on a per-directory basis
929
User selections of applications on a per-directory basis
962
339A-B
Download directories of selected applications
320
Server
Provider selections of applications
952

FIG. 9

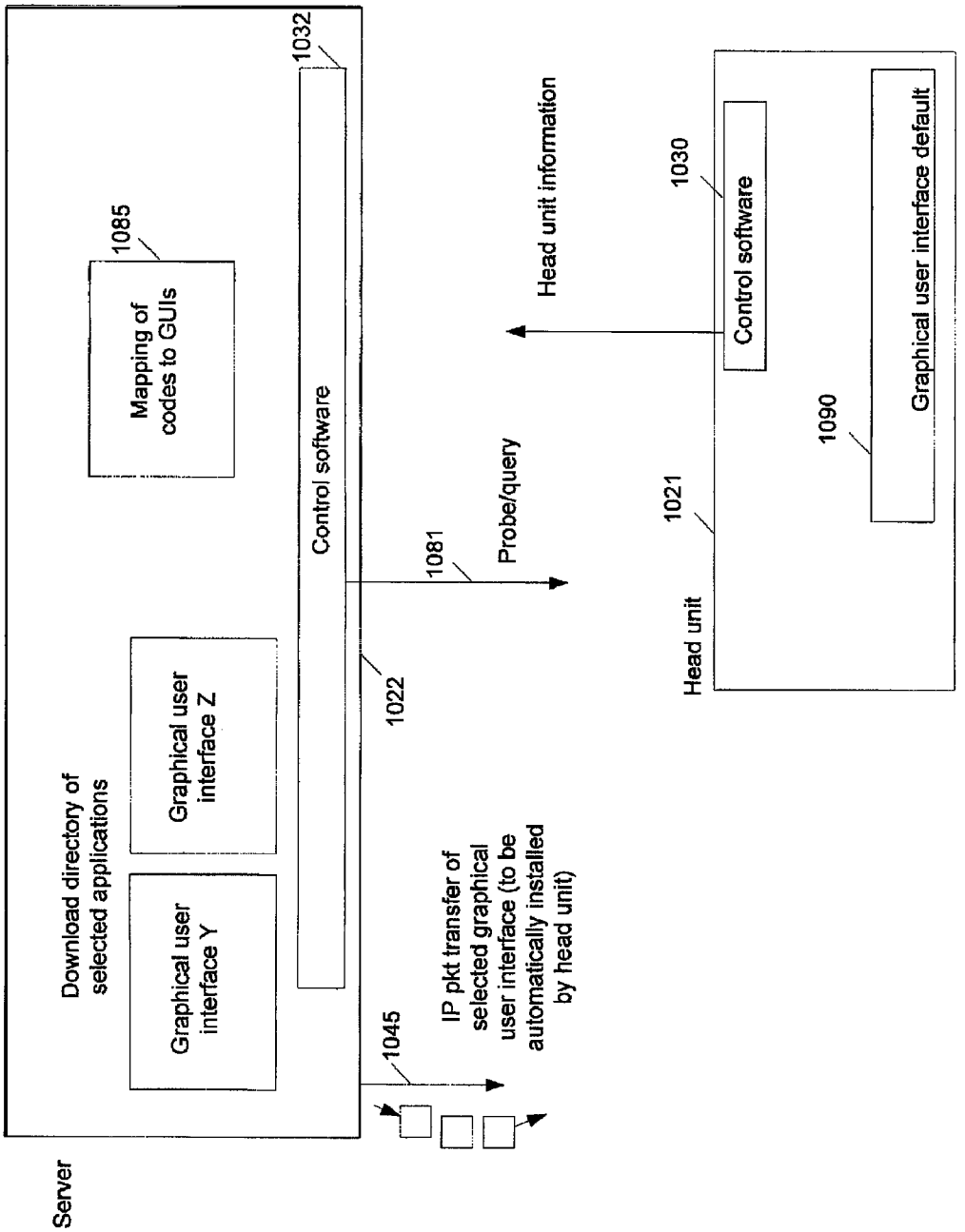

Server
Download directory of selected applications
Graphical user interface Y
Graphical user interface Z
Mapping of codes to GUIs
1085
Control software
1032
1045
IP pkt transfer of selected graphical user interface (to be automatically installed by head unit)
1022
1081
Probe/query
Head unit information
Head unit
1021
1030
Control software
1090
Graphical user interface default
1000

FIG. 10

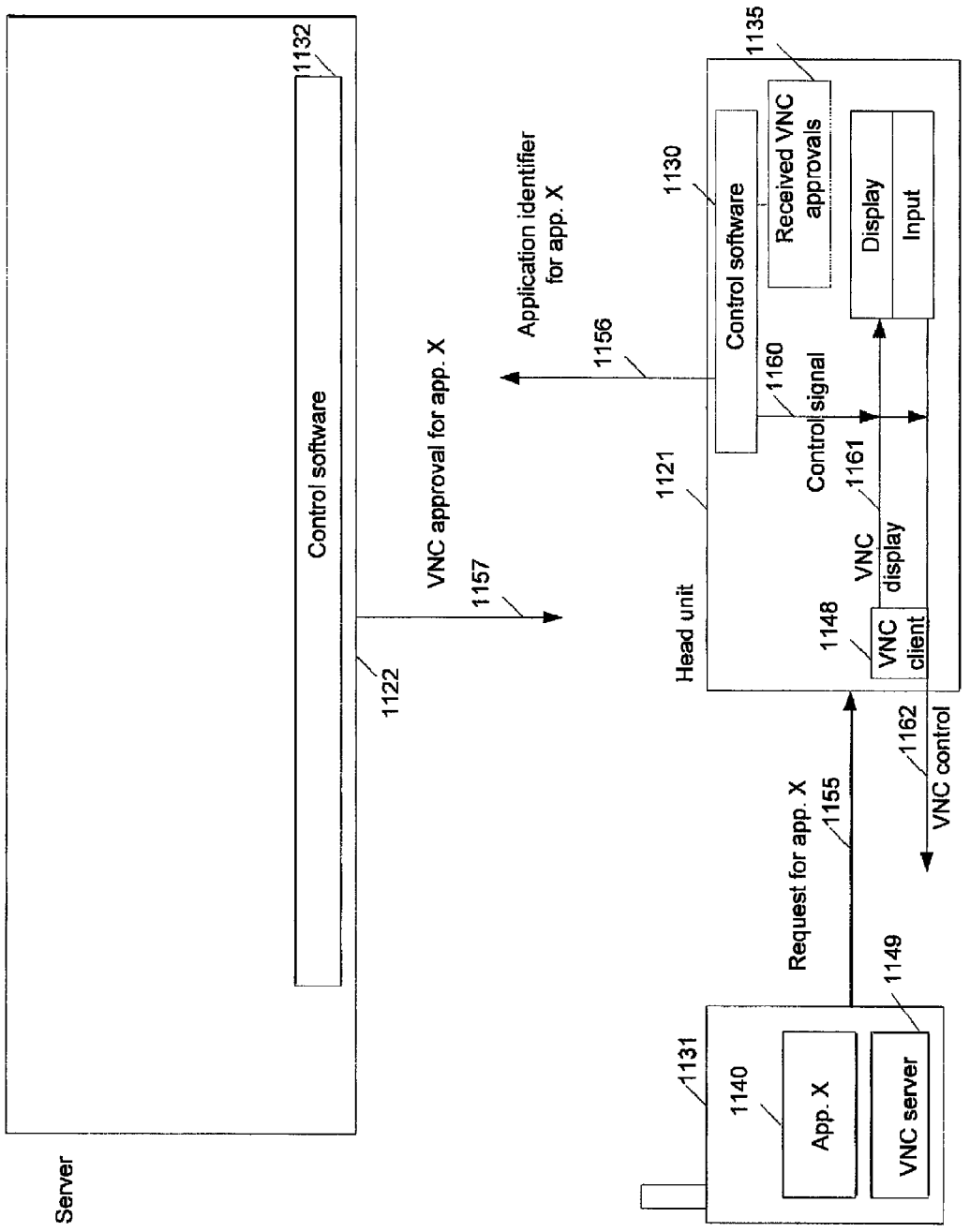

Server
Control software
1132
1122
VNC approval for app. X
1157
Application identifier for app. X
1156
1130
Control software
Received VNC approvals
1135
Display
Input
1160
Control signal
1161
VNC display
1121
Head unit
1148
VNC client
1162
VNC control
Request for app. X
1155
1149
1131
1140
App. X
VNC server
1100

FIG. 11

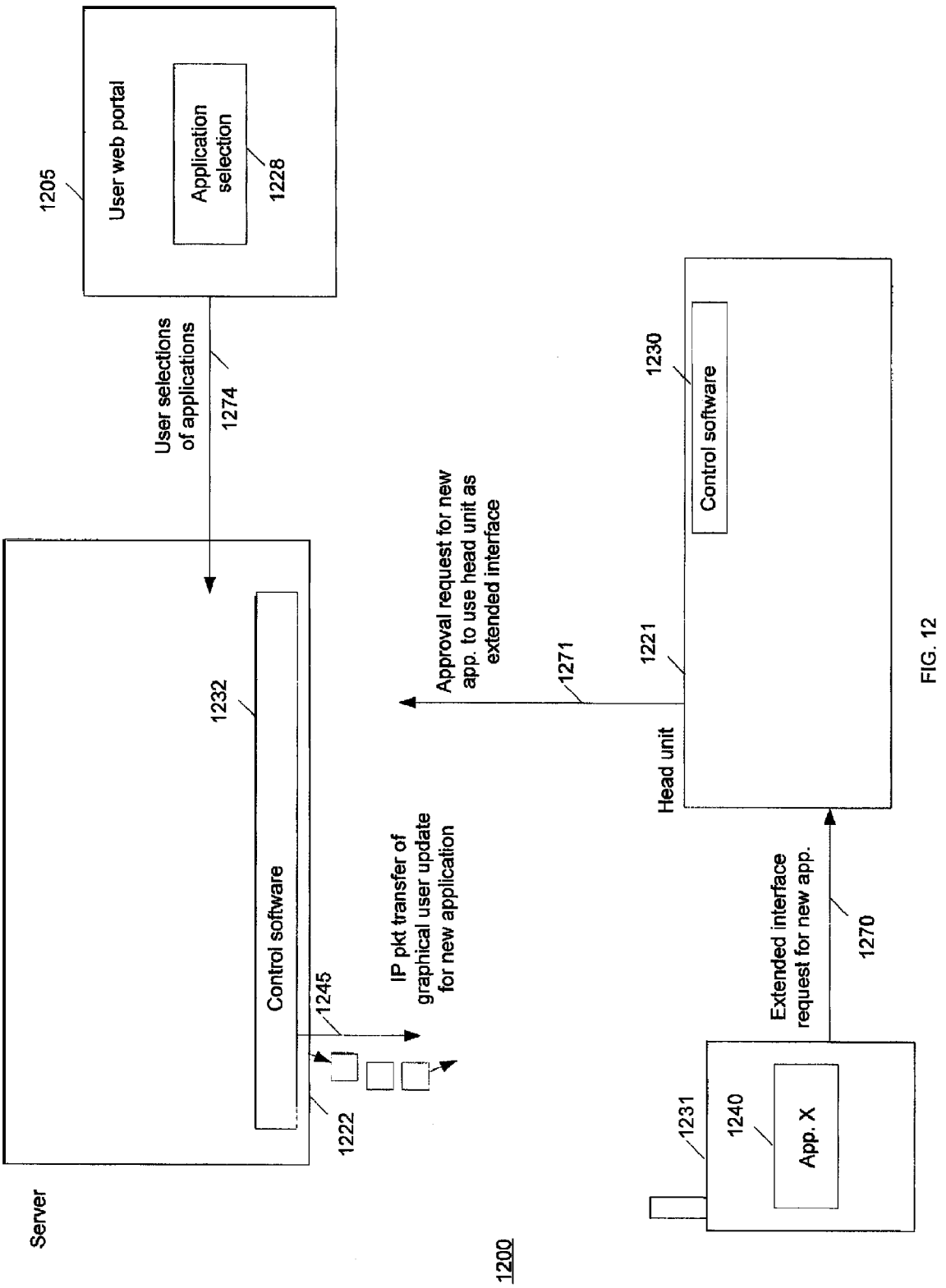

1205
User web portal
Application selection
1228
User selections of applications
1274
Server
1232
Control software
1222
1245
IP pkt transfer of graphical user update for new application
Approval request for new app. to use head unit as extended interface
1271
1221
Head unit
1230
Control software
Extended interface request for new app.
1270
1231
1240
App. X
1200

FIG. 12

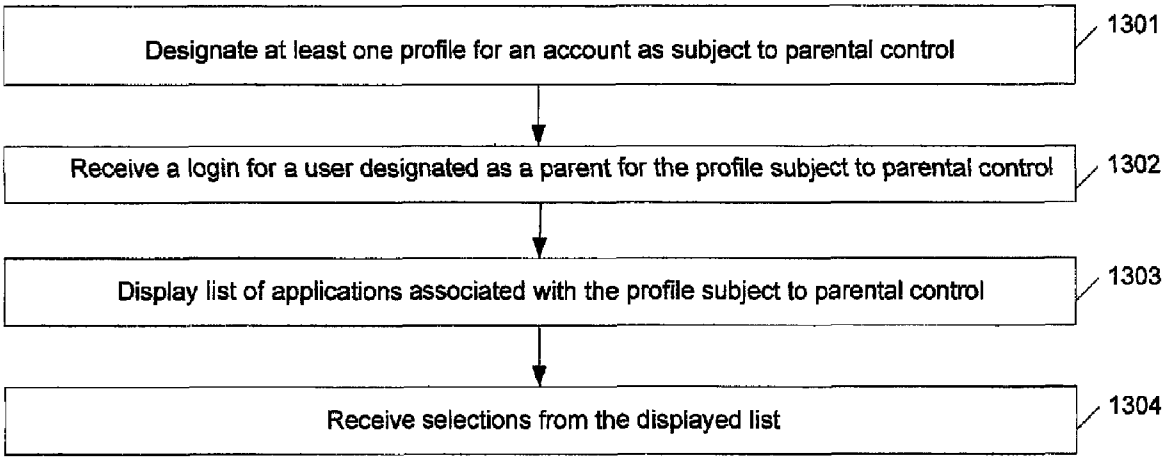

Designate at least one profile for an account as subject to parental control
1301
Receive a login for a user designated as a parent for the profile subject to parental control
1302
Display list of applications associated with the profile subject to parental control
1303
Receive selections from the displayed list
1304

FIG. 13A

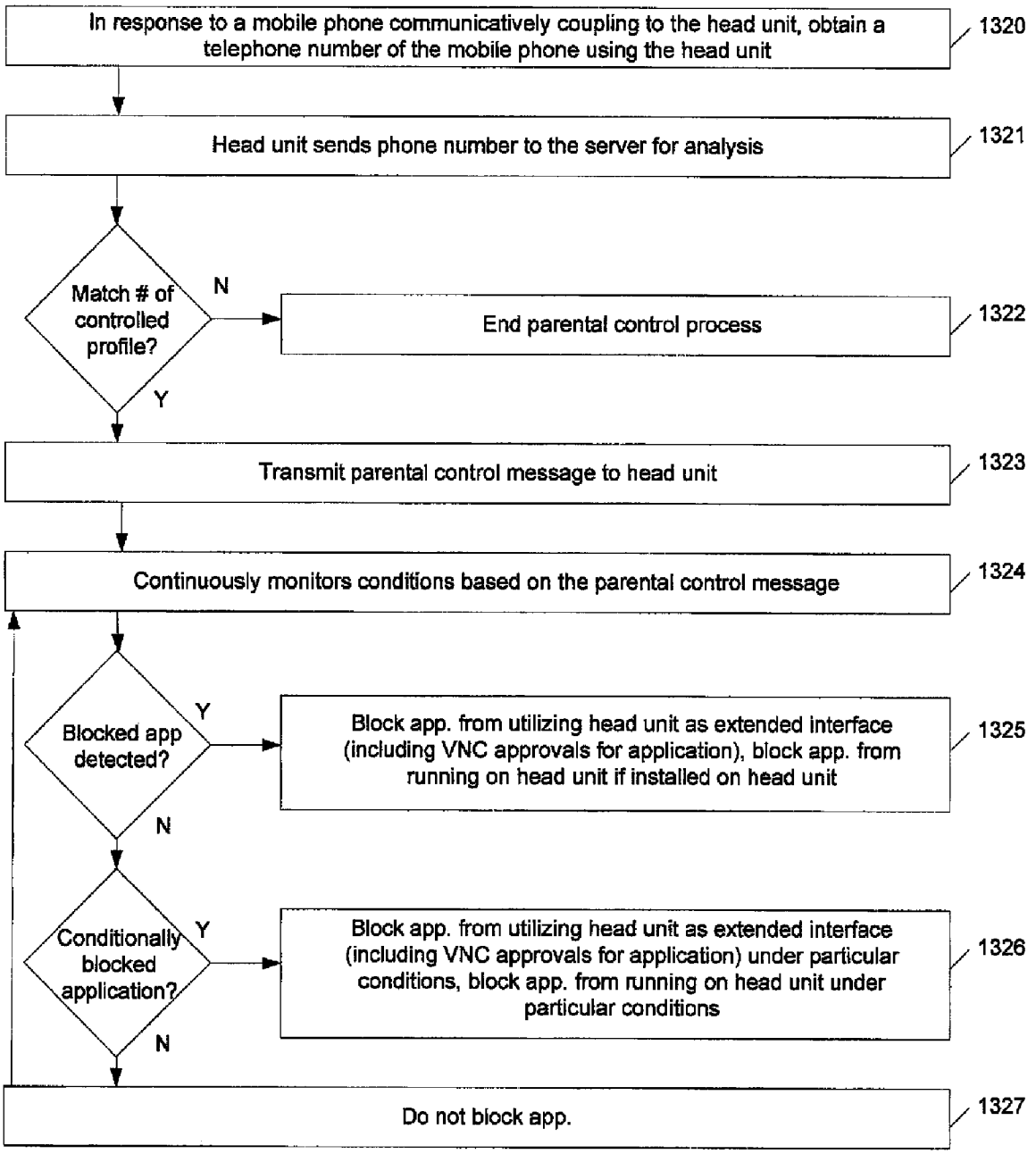

In response to a mobile phone communicatively coupling to the head unit, obtain a telephone number of the mobile phone using the head unit
1320
Head unit sends phone number to the server for analysis
1321
Match # of controlled profile?
N
End parental control process
1322
Y
Transmit parental control message to head unit
1323
Continuously monitors conditions based on the parental control message
1324
Blocked app detected?
Y
Block app. from utilizing head unit as extended interface (including VNC approvals for application), block app. from running on head unit if installed on head unit
1325
N
Conditionally blocked application?
Y
Block app. from utilizing head unit as extended interface (including VNC approvals for application) under particular conditions, block app. from running on head unit under particular conditions
1326
N
Do not block app.
1327

FIG. 13B

CENTRALIZED MANAGEMENT OF MOTOR VEHICLE SOFTWARE APPLICATIONS AND SERVICES

RELATED APPLICATIONS

This application is a continuation of Ser. No. 12/777,989 filed on May 11, 2010, entitled: CENTRALIZED MANAGEMENT OF MOTOR VEHICLE SOFTWARE APPLICATIONS AND SERVICES, which is a continuation-in-part of U.S. patent application Ser. No. 12/729,207 filed on Mar. 22, 2010, entitled: CENTRALIZED MANAGEMENT OF MOTOR VEHICLE SOFTWARE APPLICATIONS AND SERVICES, which is a non-provisional of U.S. Provisional Application No. 61/252,066 filed on Oct. 15, 2009, entitled: CENTRALIZED MANAGEMENT OF MOTOR VEHICLE SOFTWARE APPLICATIONS AND SERVICES and U.S. Provisional Application No. 61/260,781 filed on Nov. 12, 2009, entitled: CENTRALIZED MANAGEMENT OF MOTOR VEHICLE SOFTWARE APPLICATIONS AND SERVICES, each of which is herein incorporated by reference in its entirety.

COPYRIGHT NOTICE

©2010 Airbiquity, Inc. A portion of the disclosure of this patent document contains material which is subject to copyright protection. The copyright owner has no objection to the facsimile reproduction by anyone of the patent document or the patent disclosure, as it appears in the Patent and Trademark Office patent file or records, but otherwise reserves all copyright rights whatsoever. 37 CFR §1.71(d).

BACKGROUND OF THE INVENTION

A motor vehicle can be equipped with a "head unit" having a user interface. The user interface can include various resource components such as a screen, speakers, a microphone, a touch screen and/or keypad, etc. Smart phones or other mobile phones can download various applications that operate on the phone. A user can utilize a user interface of the phone to control the application and/or utilize the application in some way (such as watching the visual display or listening to the audio output).

Extending applications from the mobile phone to the head unit has become a popular feature offered by various service providers and vehicle manufacturers. As a result, the user can take advantage of better user interface components offered by the head unit (e.g. a larger screen and higher quality audio output). It is desirable to provide a mechanism to control, manage, and arbitrate the extension of mobile phone applications operating on the head unit utilizing the service control logic available in a remote server.

Vehicles can also be manufactured with components that allow the applications to be installed on the vehicle itself (as opposed to being installed on a mobile device). It is desirable to control, manage, and arbitrate the use of the vehicle interface by these applications as well.

SUMMARY OF THE INVENTION

The following is a summary of the invention in order to provide a basic understanding of some aspects of the invention. This summary is not intended to identify key/critical elements of the invention or to delineate the scope of the invention. Its sole purpose is to present some concepts of the

invention in a simplified form as a prelude to the more detailed description that is presented later.

In one example, a network device stores a mapping of application operation modes to vehicle conditions such as a first condition of the vehicle powered but not moving and a second condition of the vehicle moving. The network device receives a wirelessly transmitted request (sent by either a wireless transmitter of the vehicle or of a mobile device coupled to the vehicle) for a particular application to utilize an interface powered by the vehicle. The network device compares an application identifier specified by the received request to the mapping. The network device then identifies a portion of the vehicle interface according to the comparison and signals control software on the vehicle to grant the particular application access to only the identified portion of the vehicle interface. The application can reside on the mobile device and utilize the vehicle interface as an extended interface, or the application can reside on the vehicle itself. Additional aspects and advantages of this invention will be apparent from the following detailed description of preferred embodiments, which proceeds with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a system to control the use of a head unit as an extended interface for a phone application in a safe and intelligent manner.

FIG. **2**A illustrates a flow chart showing operation of the software **32** of FIG. **1**.

FIG. **2**B illustrates a flow chart showing a contention scheme that can be used by the software **32** of FIG. **1**.

FIG. **3** illustrates a flow chart showing operation of the software **30**A-B of FIG. **1**.

FIG. **4** illustrates a system to select and distribute applications to a vehicle in a safe and intelligent manner.

FIG. **5** illustrates a flow chart showing operation of the software of FIG. **4**.

FIG. **6** illustrates more detail of the system shown in FIGS. **4-5**.

FIG. **7** illustrates a system to select and distribute applications to a vehicle in a safe and intelligent manner according to user preferences.

FIG. **8** illustrates a flow chart showing operation of the software of FIG. **7**.

FIG. **9** illustrates more detail of the system shown in FIGS. **7-8**.

FIG. **10** illustrates a system to select a head unit graphical interface according to a configuration of the head unit.

FIG. **11** illustrates a system to generate and send remote computing approvals to the head unit.

FIG. **12** illustrates a system to push graphical user interface updates to the head unit in response to the mobile device generating a request for a new application or the user web portal selecting a new application.

FIG. **13**A illustrates a flow chart showing pre-operation of a parental control scheme.

FIG. **13**B illustrates a flow chart showing operation of the parental control scheme.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

In one example, a user couples a phone to a motor vehicle head unit using a wired or wireless connection for the purpose of using the head unit as an extended interface for the phone. The user may be permitted to control an application on the

phone using the interface of the head unit, depending on a determination via a remote server as described in the next paragraph. Similarly, the user may be permitted to watch or listen to an output of the application over the interface of the head unit, depending on a determination via a remote server as described in the next paragraph.

Novel client control software on the phone and the head unit interfaces with novel server control software on a remote server over a wireless connection extending from the phone. The client control software identifies a phone application to utilize the head unit as an extended interface. The server control software compares the identified phone application to one or more databases accessible by the remote server. Based on the comparison, the server control software determines whether the identified application will be permitted to utilize the head unit as an extended interface, and if so, which components of the head unit interface will be permitted to be used by the application. The server control software signals the client control software to control the phone and head unit according to the determination. Accordingly, any utilization of the head unit as an extended interface can be controlled in a safe and intelligent manner.

FIG. **1** illustrates a system to control the use of a head unit as an extended interface for a phone application in a safe and intelligent manner.

The system **100** includes software **30**A and **30**B configured on, respectively, a mobile phone **20** (or other mobile device) and head unit **21** (or other interface powered by a motor vehicle such as a user interface integrated with a steering wheel or a user interface integrated with a seat back). The software **30**A and **30**B interfaces with the software **32** configured on a remote server **22** to regulate and control when and how applications **40** operating on the phone **20** access I/O resources **1-4** of the head unit **21**.

FIG. **2**A illustrates a flow chart showing operation of the software **32** of FIG. **1**.

In block **201**, the software **32** receives a request for a particular application **40** on the phone **20** to utilize the interface (including input **24** resources **1-2** and output **25** resources **3-4**) of the head unit **21**. The request includes a user identifier corresponding to the user of the motor vehicle and/or head unit **21**, an application identifier corresponding to the particular application **40**, and vehicle status information. The user identifier could be an identifier provided by the user when the control software **30**A was first activated in the mobile phone **100**, user's phone number, etc.

In block **202**, the software **32** authenticates the user. This can include determining whether the user identified by the user identifier matches a database **11** of subscribers for the service of extending the interface of the phone **20** using the head unit **21**. If the user is not authenticated in diamond **203**, then in block **204**A the software **32** signals the software **30**A/B to block access by the application **40** to the head unit **21**. It should be understood that the system **100** can be configured so that block **202** is optional.

Otherwise, if the user is authenticated, then in block **204**B the software **32** authenticates the application **40** by comparing the application identifier to a list **12** of applications (also referred to as a whitelist). This list **12** can be compared by version number such that one particular version of an application **40** can be identified on the list while a different version is excluded. If the particular application **40** (or particular version) is not on the list **12** in diamond **205**, then in block **204**A the software **32** signals the software **30**A-B to block access by the application **40** to the head unit **21**.

Otherwise, if the application **40** is authenticated, then in block **206** the software **32** compares the application identifier and the current vehicle status information to a mapping **15** of application operation modes. As shown, the mapping **15** can have an entry **17** for each application **40** of the list **12**. Each entry **17** includes a mapping that is particularized for the corresponding application **40**. For example, an entry **17** for application A maps the vehicle status "vehicle moving≦than X" to resources **1**, **2**, and **4** (namely application A will be permitted to access the only the screen **1**, the speaker **2**, and microphone **4** under this vehicle condition) whereas the entry **17** for application C maps the vehicle status "vehicle moving≦than X" to only resources **2** and **4** (namely application C will be permitted to access the speaker **2** and microphone **4**). One real world example might be a navigation application A and a video game application C, where even when a passenger is present the system **100** will not allow the video game application C to be displayed on the head unit **21** screen **1** as this is deemed to be too much of a distraction for a driver whereas the navigation application A can be displayed on the head unit **21** screen **1**. Another real world application can be a vehicle with a plurality of interfaces, such as a head unit and a display attached to the back of a seat. An application can be granted access to the back seat display under conditions where the same application would not be granted access to the head unit.

It should be understood that, in other examples, the mapping **15** can be stored on the mobile phone **20**. In this case, the comparison described in the previous paragraph can be performed by the control software **30**A. In such a case, the control software **30**A checks the current vehicle status by communicating with the head unit **21**.

In block **207**, the software **32** identifies a set of some or all of the I/O resources of the head unit **21** according to the comparison. In block **208**, the software **32** signals the remote software to provide the particular application **40** access to only those ones of the I/O resources **1-4** of the identified set. In one example, such signaling can include controlling the software **30**A on the mobile phone **20** so that all access requests sent from the mobile phone **20** conform to the identified set of the I/O resources. In another example, such signaling can include controlling the software **30**B on the head unit **21** to block access requests sent from the mobile phone **20** in any manner such as by simply disabling I/O resources on the head unit **21**. In yet other examples, such signaling can include controlling both the software **30**A and the software **30**B.

FIG. **2**B illustrates a flow chart showing a contention scheme that can be used by the software **30**B of FIG. **1**. A contention scheme can be utilized in addition to the scheme shown in FIG. **2**A.

In block **209**, the software **30**B determines whether any of the I/O resources of the identified set are currently in use. If none are in use in diamond **210**, then in block **211**A the software **30**B provides the particular application access to only those I/O resources of the identified set.

Otherwise, if at least one of the resources of the set is in use, then in block **211**B the software **30**B identifies a by-resource ranking **13** of the applications for each of the in-use resources of the identified set. This is shown in FIG. **1** where there is a ranking **13** for each resource **1-4**. In block **212**, the software **30**B compares the application identifier to the by-resource ranking(s) **13** to determine whether the application **40** has priority for any of the in-use resources of the identified subset (the may be performed via signaling since the ranking **13** is shown on the remote server or the ranking may have been sent to the vehicle interface in an earlier process). This comparison will indicate whether the application currently using a particular in-use resource is deemed higher or lower priority than

the requesting application for that in-use resource. In block **213**, the software **30**B provides the particular application **40** access to only those ones of the I/O resources **1-4** of the identified set that are also not currently in use or are in use by a lower priority application.

FIG. **3** illustrates a flow chart showing operation of the software **30**A-B of FIG. **1**.

In block **301**, the software **30**A-B sends a request for a particular application **40** on the phone **20** to utilize the interface of the head unit **21**. In block **302**, the software **30**A-B receives back a signal indicating whether or not the application **40** is authorized to access the head unit **21** at this time, and if so, an identification of which resources **1-4** can be utilized. If the application **40** is not authorized in diamond **303**, then in block **304**A the software **30**A-B outputs a notification that the application **40** is not authorized to access the head unit. This notification could be output by the mobile phone **20** or the head unit **21**, or both.

Otherwise, if the application **40** is authorized in diamond **303**, then in block **304**B the software **30**A-B controls the mobile phone **20** and the head unit **21** to cause the application **40** to be extended to the identified resources. If only a subset of possible resources for the application **40** (from the respective mapping **17**) are utilized due to a conflict, then the software **30**A-B may generate a notification to alert the driver about the lower priority application being suspended before activating the higher priority application. In another example, if the resources are currently used by a lower priority application, software **30**A-B can automatically suspend/end the lower priority application and allow the higher priority application to be activated using the required resources.

If it is determined that application **40** can be extended to the head-unit **21**, the server **22** can download corresponding "control panel" software to the head unit to control the application **40**. By having downloading this software to the head unit **21** based on the application being requested, a service provider can customize and update the "control panel" accordingly when new applications or update to existing applications are available. The head-unit can have a web-code renderer to display the "control panel" software.

Referring again to FIG. **1**, the software **30**A-B interfaces with the software **32** over a wireless connection extending from the phone **20**. This wireless connection can utilize a packet data connection (including but not limited to GPRS, EDGE, EVDO, UTMS, WiMAX, WiFi, etc.), Short Message Service (SMS), or In-Band-Signaling modems on the mobile phone **20** and the remote server **22** as described in U.S. Pat. Nos. 6,144,336; 6,690,681; and 6,493,338.

Still referring to FIG. **1**, it is noted that the mobile phone **20** can couple to the head unit **21** by using a connection such as a USB, Bluetooth, or WiFi connection. These are just examples, however, and in other cases a different connection and/or protocol may be suitable for utilizing the interface of the head unit **21** for the application **40** of the phone **20**.

It should be understood that the mapping **15** can have any vehicle statuses and that the four illustrated examples are merely some examples. For example, another vehicle status could be whether the vehicle is moving more than speed 'X' AND a passenger is present.

It should be understood the head unit **21** can include less than all the example resources shown, or other resources that are not shown. For example, another possible I/O resource component is a text to speech component.

In the illustrated example, a first application can be permitted to access a first subset of whichever resources are actually present on the head unit **21** based on an intelligent decision by the system **100**, while a second different application can be permitted to access a second subset of the resources, or even all of the resources.

It should be understood that the applications **40** can be ranked "by resource" as illustrated or there can be a single ranking including all the applications **40**. The system **100** is implemented with the "by resource" ranking as shown, but the concepts described herein could be implemented in another system that ranks applications independently of resource.

FIG. **4** illustrates a system to select and distribute applications to a vehicle in a safe and intelligent manner.

One difference between the previously discussed system of FIG. **1** and the system of FIG. **4** is the install location for applications. Whereas the applications A-C in the system **100** of FIG. **1** are installed and operating on the mobile phone **20** (using the head unit **21** or other interface powered by the vehicle as an extended interface), the applications J-L in the system **200** of FIG. **4** are installed on the head unit **221** or other component powered by the vehicle. In system **200** of FIG. **4**, the software **230-232** enables a provider to select which applications can be installed on the head unit **221** and control distribution of the selected applications to the vehicle.

Before discussing the details of system **200** in the following paragraphs, it should be apparent that the structures and functions of system **100** described in FIGS. **1-3** can be combined with the structures and functions of system **200** (FIGS. **4-6**) into a single system. For example, a single system could include some applications installed on a mobile phone using an interface of a vehicle as an extended interface and some applications installed on a component of the vehicle.

FIG. **5** illustrates a flow chart showing operation of the software of FIG. **4**.

In block **501**, in response to the vehicle being powered up, the control software **230** sends a signal **244** to the server **222** indicating vehicle power-up. The signal **244** can be sent over a local connection such as a USB or Bluetooth connection to be relayed by the mobile device **220** over a wireless telecommunications network.

In block **502**, the software **232** checks a download directory **239** (sometimes referred to as a "sandbox") associated with the vehicle to determine if there are any applications to be downloaded to the vehicle. A scheme for intelligently selecting applications that are present in the download directory **239** will be discussed in detail later with reference to FIG. **6**.

If the check by the software **232** indicates that the download directory **239** includes at least one application, the process continues. For now, let it be assumed for the purposes of illustration that the download directory **239** includes applications **240** (J-L). Accordingly, in block **503** the software **232** generates and sends signaling **245** to cause the IP gateway software **231** on the mobile phone **220** to operate as an IP gateway for forwarding applications to the head unit **221**. In one example, signaling **245** includes communications to dynamically load the mobile phone **220** with the software **231** in response to the determination in block **502** and cause the software **231** to operate thereon for the download to vehicle. The signaling **245** may not take place if the mobile phone **220** is already loaded with the software **231** and ready for IP gateway operation. In other examples, the signaling **245** could originate from the control software **230** on the head unit **221** in response to detecting vehicle power-up.

In block **504**, the software **232** generates and sends IP packets **250** to download the applications **240** onto the vehicle. The IP packets **250** are received by the mobile phone **220** and forwarded by operation of the software **231** to the head unit **221**. In block **505**, the software **230** receives the IP

packets **230** and installs the applications **240** (J-L) on the vehicle (installation can be on components of the head unit **221** or other vehicle components).

Thereafter, a user of the vehicle can operate the applications J-L using the head unit **221** as an interface. It should be understood that the software **230** and **232** can operate according to any of the principles described in FIGS. **1-3**. For example, the software **230** and **232** can regulate utilization of the I/O resources of the head unit **221** by the active application(s) according to current vehicle status. As another example, in systems where applications are installed on both the vehicle and a mobile device, the software **230** and **232** can include all applications that utilize the vehicle interface in an application ranking/priority table similar to the table **13** (FIG. **1**).

In one example, the head unit **221** includes a web code renderer **299**, for example an HTML renderer, controlled via the software **230**. The web code renderer **299** is configured to display HTML code, but unlike a browser, does not allow a user to freely navigate to web locations. Specifically, the web code renderer **299** displays only applications allowed by the provider, e.g. specified by the server **222**.

It should be understood that the flow chart described above addresses updating applications installed on the vehicle. The vehicle can also be pre-loaded with certain applications so that some of the applications installed on the vehicle are downloaded according to the flowchart while others are installed thereon during manufacturing.

Thus, based on the principles described above, vehicles can be manufactured with none of the applications installed on the vehicle but instead the applications can downloaded to the vehicles when the drivers are present in the vehicles. The types of applications downloaded to the vehicles are governed by preferences defined in the network server provided by the drivers.

FIG. **6** illustrates more detail of the system shown in FIGS. **4-5**.

It was previously explained that the server **222** includes a download directory **239** of applications waiting to be downloaded on a per-vehicle basis. FIG. **6** illustrates the user web portals **601**, **604**, and **605** that can be involved in selection of the applications in the download directory **239** and describes an example use of these web portals **601**, **604**, and **605**.

A provider such as an OEM of the vehicle operates the web portal **601**. Using an interface such as a computing terminal **625**, the provider controls an application selection portion **608** of the web portal **601** with communications **650** to assemble the controlled list **610** of applications from the list **609** of all applications that can be installed on the vehicle. Typically building the list **610** from the list **609** involves validation of the applications from a technical standpoint and/or a business standpoint of the provider.

The provider also sends communications **651** to select applications from the controlled list **610** to be installed on a particular vehicle. These selections may be based on a mapping a vehicle models to applications, for example. These selections **652** fed into the download directory **239**.

Regarding the list of all available applications **609**, it should be understood that this list can be assembled by applications developed by the provider and/or third parties. In the case of third parties providing applications, the third party uses the application submission **618** portion of the web portal **604** (which is hosted by a web server operated by the provider in one example) to submit an application **649** to be included in the list **609**.

A vehicle user can also select applications to be included in the download directory **239** using a computing terminal **626**, for example using any internet accessible computing device such as the mobile device or a desktop computer. The computing terminal **626** accesses the application selection portion **628** of the user web portal **605** (which is hosted by a web server operated by the provider in one example) to view the controlled list **610** of applications that can be installed on his vehicle. The user can then send communications **661** to select applications from the controlled list **610** that the user would like installed on his vehicle. These selections **662** are fed into the download directory **239**.

The user web portal **605** can also be configured to allow a user to remove particular applications from the download directory **239**, e.g. the user may desire to remove one of the provider selected applications **652** added to the download directory **239** via the provider. Removal can be by deletion of an application already sent to the directory **239** or by indicating that a particular application is not desired before such application is ever added to the download directory **239**.

According to the above, applications can be accumulated into the per-vehicle download directory **239**. At vehicle power-up, such applications can be downloaded and installed onto the vehicle. The download directory **239** can then accumulate new applications until a next vehicle power up.

It should be understood that an interface similar to that of the web portal **605** can be displayed on the head unit of the vehicle. The user could then make selections from such interface for selecting applications from the controlled list **610**. The selected applications could be downloaded immediately to the vehicle instead of being put in the download directory when the selections are made from the interface.

FIG. **7** illustrates a system to select and distribute applications to a vehicle in a safe and intelligent manner according to user preferences.

One difference between the previously discussed system of FIG. **1** and the system of FIG. **7** is the install location for applications. Whereas the applications A-C in the system **100** of FIG. **1** are installed and operating on the mobile phone **20** (using the head unit **21** or other interface powered by the vehicle as an extended interface), the applications M-P/Q-S in the system **300** of FIG. **7** are installed on the head unit **321** or other component powered by the vehicle. In system **300** of FIG. **7**, the software **330-332** enables a provider to select which applications can be installed on the head unit **321** and control distribution of the selected applications to the vehicle.

Before discussing the details of system **300** in detail in the following paragraphs, it should be apparent that the structures and functions of systems **100** and **200** described in FIGS. **1-6** can be combined with the structures and functions of system **300** (FIGS. **7-8**) into a single system. For example, a single system could include some applications installed on a mobile phone using an interface of a vehicle as an extended interface and some applications installed on a component of the vehicle.

FIG. **8** illustrates a flow chart showing operation of the software of FIG. **7**.

In block **801**, the head unit **321** communicatively couples to a mobile device such as mobile phone **320**. In one example, the connection **540** is established via Bluetooth pairing of the head unit **321** and the mobile phone **320**. The Bluetooth pairing can be in response to the vehicle being powered up (causing the head unit to power up and search for a Bluetooth device), although it should be apparent that Bluetooth pairing could result from other circumstances such as the mobile phone **320** powering up, the mobile phone **320** being brought within range of the head unit **321**, re-pairing after another Bluetooth device is disconnected from the head unit **321**, etc. In other examples, the communicative connection can be

established by a user connecting the mobile phone **320** to the head unit **321** using a USB connection.

In block **802**, the control software **330** accesses a telephone number of the mobile phone **320**. It should be understood that mobile phones are activated with a particular phone number in conjunction with subscribing to a call plan, which is the phone number the control software **330** reads from the mobile phone **320**. In one example, the signaling **542** to obtain the phone number is performed using Bluetooth signaling.

In block **803**, the control software **330** sends signaling **543** to the server **322**. The signaling **543** can be sent over a local connection such as a USB, Bluetooth, or WiFi connection to be relayed by the mobile device **320** over a wireless telecommunications network. The content of the signaling **543** can be similar to the signal **244** described in more detail previously with respect to FIG. **4**, but in addition, can provide the obtained phone number.

In block **804**, the control software **332** compares the phone number included in the signaling **543** to the mapping **350**. The mapping correlates each of a plurality of download directories A-B accessible via this particular head unit **321** to a particular phone number. For example, in the mapping a first phone number is correlated with the download directory A and a second phone number is correlated with the download directory B. The control software **332** selects one of the download directories A-B based on the comparison of the received telephone number to the mapping **350**.

The software **332** then checks the selected one of the download directories A-B to determine if there are any applications currently stored in the selected directory. A scheme for intelligently selecting applications that are present in the download directories A-B will be discussed in detail later with reference to FIG. **9**. For now, let it be assumed for the purposes of illustration that the download directories **339**A and **339**B currently include applications **340**A (M-P) and **340**B (Q-S), respectively, in addition to the head unit frontend configurations **369**A and **369**B.

As noted briefly in the previous paragraph, the download directories A-B include head unit frontend configurations A-B, respectively, in addition to the applications **340**A and **340**B. The configurations A-B can be stored as HTML code or other web code compatible with the web code renderer of the **399**. Depending on which one of the head unit frontend configurations A-B is downloaded to the head unit **321**, a display **380** of the head unit **321** will display a different graphical user interface. Each of the different web code files **369**A and **369**B will produce a different graphical user interface when displayed using the display **380** and the renderer **399**. For example, each graphical user interface could have its own user customized settings such as a particular wallpaper selected by a user. A scheme for generating the different head unit frontend configurations A-B will be discussed in detail later with reference to FIG. **9**.

In block **805**, the software **332** generates and sends signaling to cause the IP gateway software **331** on the mobile phone **320** to operate as an IP gateway for forwarding applications to the head unit **321** similar to the scheme described in FIG. **4**. In one example, similar to FIG. **4**, such signaling includes communications to dynamically load the mobile phone **320** with the software **331** to cause the software **331** to operate thereon for the download to vehicle. This signaling may not take place if the mobile phone **320** is already loaded with the software **331** and ready for IP gateway operation. In other examples, the signaling **345** could originate from the control software **330** on the head unit **321** after the connection **540** is established.

In block **806**, the software **332** generates and sends IP packets **545** to download the data from the selected one of the directories onto the vehicle, e.g. either applications M-P and configuration A or applications Q-S and configuration B. The IP packets **545** are received by the mobile phone **320** and forwarded by operation of the software **331** to the head unit **321**. It should be understood that in this particular illustration the IP packets **545** include both applications and a configuration for the graphical user interface, but in other scenarios the IP packets **545** might contain either an application or a configuration. Also, it should be apparent that, if there are no applications currently in the selected download directory and there have been no changes to the configurations stored in the download directory since a previous download, then the IP packets **545** may not be sent.

In block **807**, the software **330** receives the IP packets **545** and installs the applications included therein on the vehicle (installation can be on components of the head unit **321** or other vehicle components). The software **330** also processes the configuration from the IP packets **545** using the web code renderer **399** to generate a particular graphical user interface based on the detected phone number.

Thereafter, the graphical user interface output via the display **380** will correspond to one of the configurations A-B stored in the selected download directory. A user of the vehicle can operate the installed applications M-P or Q-S using the head unit **321** as an interface.

It should be understood that the software **330** and **332** can operate according to any of the principles described in FIGS. **1-3**. For example, the software **330** and **332** can regulate utilization of the I/O resources of the head unit **321** by the active application(s) according to current vehicle status. As another example, in systems where applications are installed on both the vehicle and a mobile device, the software **330** and **332** can include all applications that utilize the vehicle interface in an application ranking/priority table similar to the table **13** (FIG. **1**).

In the example described above, the control software **330** accesses a phone number of the mobile phone **320** to uniquely identify the mobile phone **320** from other mobile phones. In other examples, control software on the head unit **321** can access a different value on a communicatively coupled mobile phone to uniquely identify the mobile phone from other mobile phones. Other examples of values can include, but are not limited to, a physical address of the mobile phone. In such other examples, it should be apparent that such values are used in the mapping, e.g. if the other values are physical addresses then the mapping includes physical addresses correlated to download directories.

In the example described above, the control software **330** sends the accessed unique identifier (phone number in this example) to the server **322**. In other examples, the mapping **350** can be stored on the vehicle. In such a case, the control software **330** identifies a particular download directory listed in the mapping according to the comparison and sends an identifier specifying the particular download to the server **322**. The server **322** may then respond with IP packets **545** sending data from the identified download directory.

FIG. **9** illustrates more detail of the system shown in FIGS. **7-8**.

It was previously explained that the server **322** includes a plurality of download directories **339**A-B of applications waiting to be downloaded. FIG. **9** illustrates the user web portal **905** that can be involved in creating the download directories **339**A-B and selection of the applications on a per-directory basis and describes an example use of this web portal **905**.

A vehicle user can create a plurality of profiles corresponding to the vehicle using the profile creation portion **930** of the user web portal **905**. A profile can be created for each person that may use the vehicle. A field **927** requests a unique phone number or other unique identifier of a mobile phone respectively corresponding to each person. A name of each person or other information for each person may be gathered with the phone number(s). After or during profile creation, server **322** creates a download directory for each profile and updates the mapping **350** for each number/directory combination. In some examples, the portion **930** can be configured to allow a user to rank the created profiles so that, if the head unit can be coupled to more than one of the mobile devices simultaneously (it can depend on the connection protocol whether this is possible), a higher ranked one of the corresponding profiles will be used.

During or after profile creation the web portal **905** can be operated to select applications to be included in the download directories **339**A-B using a computing terminal **926**, for example using any internet accessible computing device such as the mobile device or a desktop computer. The computing terminal **926** accesses the application selection portion **928** of the user web portal **905** (which is hosted by a web server operated by the provider in one example) to view the controlled list of applications that can be installed on the vehicle. The user can then send communications **961** to select applications from the controlled list that the user would like installed on his vehicle on a per-directory basis. These selections **962** are respectively fed into the download directories **339**A-B on a per-directory basis.

The user web portal **905** can also be configured to allow a user to remove particular applications from the download directories **339**A-B, e.g. the user may desire to remove one of the provider selected applications **952** added to the download directory **339**A or **339**B via the provider on a per-directory basis. Removal can be by deletion of an application already sent to the download directory **339**A or **339**B, or by indicating that a particular application is not desired before such application is ever added to the download directory **339**A or **339**B.

The user web portal **905** can also include a head unit frontend configuration customization portion **928**. This portion **928** allows new configurations **369**A-B to be added to the download directories **339**A-B, with each person's configuration customized according to their requests. For example, a first wallpaper background can be added to the download directory **339**A and a second different wallpaper background can be added to the download directory **339**B. Other customizations can include customized graphical interface buttons, customized graphical user interface layout, custom images, etc.

According to the above, applications can be accumulated into the per-vehicle download directories **339**A-B on a per-directory basis. Upon the head unit coupling to a particular one of the mobile devices, data from a corresponding one of the download directories **339**A-B can be downloaded and installed onto the vehicle to provide a customized application set and a customized user interface.

It should be understood that an interface similar to that of the web portal **905** can be displayed on the head unit of the vehicle. The user could then make selections from such interface for selecting applications from the controlled list. The selected applications could be downloaded immediately to the vehicle instead of being put in the download directory when the selections are made from the interface.

FIG. **10** illustrates a system to select a head unit graphical interface according to a configuration of the head unit.

The system **1000** includes a server **1022** and a head unit **1021** that can include components similar to any of the previously described servers and head units. It should be appreciated that the server **1022** and the head unit **1021** communicate using a mobile device (not shown) that is coupled to the head unit **1021**. The head unit **1021** includes control software **1030** and the server **1022** includes control software **1032**.

The software **1032** identifies a configuration of the head unit **1021**, for example, by probing **1081** the head unit **1021** to collect information. The software **1030** responds **1082** with information identifying the configuration of the head unit **1021**. The response **1082** can include at least one of the following: a make/model/year of the vehicle, a predefined code, or an ad hoc listing of the configuration of the head unit **1021** (such as color/monochrome display, native resolution, etc.)

The software **1032** then selects from a plurality of graphical user interfaces based on the head unit information **1082**. For example, if the head unit information **1082** includes a predefined code, the software **1032** can compare the code to a stored mapping **1085** of codes to graphical user interfaces Y-Z. The selected graphical user interface corresponds to a particular configuration of the head unit **1021** as reported by the information **1082**. For example, if the head unit **1021** has a monochrome display, the selected Graphical User Interface (GUI) may be interface Y, whereas if the head unit **1021** has a color display, the selected GUI may be interface Z. Or, perhaps if the head unit **1021** has a native resolution of a first value, the selected GUI may be interface Y, whereas if the head unit **1021** has a native resolution of a second value, the selected GUI may be interface Z. If the make/model/year of the car indicates an interior of a first design, say a luxury motif, the selected GUI may be interface Y, whereas if the make/model/year of the car indicates an interior of a second design, say a sporty motif, the selected GUI may be interface Z.

Once a graphical user interface has been selected, the software **1032** conducts an IP packet transfer **1045** of the selected one of the graphical user interfaces Y-Z. It should be understood that the IP packet transfer **1045** may utilize the previously-described IP gateway software of the mobile phone (not shown). The software **1030** automatically installs the received graphical user interface. The selected graphical user interface can replace a default graphical user inference **1090** or previously downloaded graphical user interface residing on the head unit **1021** prior to the transfer **1045**.

It should be understood that the previously described frontend configurations can be applied to the selected and installed GUI. For example, a selected GUI can be installed on the head unit **1021**, and then further modified in appearance based on a customized frontend selection according to a telephone number of the mobile device currently coupled to the head unit **1021**.

FIG. **11** illustrates a system to generate and send remote computing approvals to the head unit.

The system **1100** includes a server **1122** and a head unit **1121** that can include components similar to any of the previously described servers and head units. It should be appreciated that the server **1122** and the head unit **1121** communicate using a mobile device **1131**. The head unit **1121** includes control software **1130** and the server **1122** includes control software **1132**.

The head unit **1121** includes a remote desktop viewing program such as a Virtual Network Computing (VNC®) client **1148** to connect to the VNC server **1149** running on the mobile device **1131**. By way of background, a VNC client and server communicate to display the server's desktop or other

current view on the client's display. The human interfaces device(s) directly connected to the client, e.g. keyboard, mouse, etc., can then be used in conjunction with the displayed image to remotely control the computing device running the VNC server. If an application is running in full screen mode on the computing device with the VNC server, then the computing device with the VNC server controls that application (rather than the entire desktop).

The control software **1130** receives a request **1155** from the mobile device **1131** specifying a particular application X (**1140**). The control software **1130** identifies the application identifier corresponding to the request **1155** either by extracting the identifier itself from the request **1155** or using a lookup based on information gleaned from the request or from any communication with the mobile device **1131**. The control software **1130** sends the communication **1156** containing the application identifier.

The control software **1132** compares the application identifier to an internal table and generates a VNC approval **1157** for the application X. The VNC approval **1157** specifies the particular conditions under which VNC is approved in conjunction for this application X. For example, if the application X is a navigation application, the approval **1157** might specify that VNC is approved when the vehicle is stopped or moving. In contrast, if the application X is a media creation application, the approval **1157** might specify that VNC is approved only when the vehicle is stopped.

The VNC approval **1157** can also specify different approvals based on whether the application is currently running in full screen mode or windowed mode. For example, the navigation application might be approved when the vehicle is moving, but only as long as the navigation application is running on the mobile device **1131** in full screen mode. This will prevent VNC functionality immediately if the user switches the navigation application into windowed mode while the vehicle is moving.

The VNC approval **1157** can also specify telephone numbers. For example, VNC can be permitted when the mobile device **1131** is running a media player application, but only if the mobile device has a particular telephone number (this can be used as a form of parental control).

The control software **1130** stores the received VNC approval **1157** in a database **1135** of VNC approvals. The control software **1130** continuously monitors conditions based on the VNC approvals stored in the database **1135** to generate the control signal **1160**. The control signal **1160** controls whether a view **1161** of the mobile device **1131** can be currently displayed on a display of the head unit **1121** by the VNC client **1148**. The control signal **1160** also controls whether inputs made using an input interface of the head unit **1121** will be sent **1162** to the VNC server **1149**.

FIG. **12** illustrates a system to push graphical user interface updates to the head unit in response to the mobile device generating a request for a new application or the user web portal selecting a new application.

The system **1200** includes a server **1222** and a head unit **1221** that can include components similar to any of the previously described servers and head units. It should be appreciated that the server **1222** and the head unit **1221** communicate using a mobile device **1231**.

The server **1222** can receive an indication of a new application to be used in the system **1200** in at least two different forms (the term new application refers to an application that has not previously been downloaded to the head unit **1221** and/or utilized the head unit **1221** as an extended interface). In one form, the mobile device **1231** sends an indication of a new application X (**1240**) to utilize the head unit **1221** as an extended interface. More specifically, this indication is an approval request **1271** generated and sent by the control software **1230** in response to receiving a request **1270** from the mobile device **1231**.

Another way the server **1222** can receive an indication of a new application is from control over the user web portal **1205**. The user web portal **1205** is similar to the previously described web portals. Using an application selection tool **1228**, a user can use any remote computer to select applications to be included in a corresponding download directory (not shown) for installation on the head unit. Thus, a received selection **1274** including a new application is another form of indication of a new application to be used in the system **1200**.

In response to detecting such an indication, the control software **1232** determines whether to transmit an IP packet transfer **1245** including a graphical user interface update for the new application X. It should be apparent that no such IP packet transfer will be sent if the new application X is not included in the previously discussed controlled list of applications (FIG. **6**). In one example, the graphical user interface update modifies a previously selected and installed graphical user interface (FIG. **10**) to add an icon for accessing the new application X. In another example, the graphical user interface update includes any other form of update to a previously selected and installed graphical user interface for operating new application X. The control software **1230** automatically installs the update in response to the sending of the request **1270** and/or the selections **1274**. It should be apparent that the transfer **1245** can be included with a download of the application itself in the case that the download is waiting for vehicle power up in a download directory.

FIG. **13**A illustrates a flow chart showing pre-operation of a parental control scheme.

In block **1301**, the server designates at least one profile as being subject to parental control. This profile can be selected by the account holding, for example, by marking a selection using the web portal.

In block **1302**, the server receives a login for a user designated as a parent (typically the account holder) for the profile subject to parental control. In block **1303**, the server causes a list of applications associated with the profile subject to parental control to be displayed using the web portal.

In block **1304**, after displaying the list, the server receives selections from the displayed list. The server may store these selections in the profile that is subject to parental control. The selections can include applications from the list and/or more detailed information in the case of a conditional approval (a conditional approval is discussed later in more detail).

FIG. **13**B illustrates a flow chart showing operation of the parental control scheme.

In block **1320**, in response to a mobile phone communicatively coupling with the head unit, the head unit obtains a telephone number of the mobile phone to be used to communicate with the server. In block **1321**, the head unit sends the phone number to the server for analysis. If the obtained phone number does not match a profile designated as subject to parental control, then the parental control process completes in block **1322**.

Otherwise, if the obtained phone number does correspond to the profile subject to parental control, then in block **1323** the server executes parental control. In one example, such execution includes blocks **1323**-**1327**, similar to the VNC approval process, discussed in the next paragraph.

In block **1323**, the server transmits a parental control message to the head unit. In block **1324**, the head unit continuously monitors conditions based on the parental control message. In block **1325**, the head unit blocks a particular

application from using the head unit as an extended interface and/or blocks a particular application installed on the head unit from running. For example, the head unit might receive an indication that the particular mobile phone has received a telephone call, but then block the use of the head unit as an extended interface for the telephone call. Or, the head unit might block an attempt to run a media player application on the head unit in another example. The continuous monitoring may be facilitated by a database on the head unit storing received parental control messages.

In block **1326**, the head unit conditionally blocks a particular application from using the head unit as an extended interface and/or running directly on the head unit. For example, the head unit might receive an indication that the particular mobile phone has received a telephone call, but then block the use of the head unit as an extended interface conditionally based on a value of a caller ID field on the incoming call. More specifically, the parental control message might designate certain telephone numbers as exceptions to preventing the head unit from providing an extended interface for the telephone. The head unit obtains the caller ID value from the mobile phone and blocks the mobile phone from utilizing an interface of the head unit conditionally. In another example, the head unit might block an application conditionally based on a condition of the vehicle, e.g. the head unit blocks the mobile phone from utilizing an interface of the head unit only if the vehicle is currently moving.

In block **1327**, the head unit does not block the particular application if the application is permitted according to the parental control message. In this case, the head unit allows the application to operate according to approval by the server, e.g. according to whether the application is on the controlled list (FIG. **6**).

It should be apparent that, in other examples, a system can enforce a parental control scheme using different processes than those specifically described above. For example, in another example, the processes of blocks **1323-1327** are not used. Instead, the head unit continuously reports conditions and application requests to the server, which dynamically withdraws a current approval according to the parental control settings. The server then controls the head unit to block a current disapproved application.

It will be obvious to those having skill in the art that many changes may be made to the details of the above-described embodiments without departing from the underlying principles of the invention. The scope of the present invention should, therefore, be determined only by the following claims.

Most of the equipment discussed above comprises hardware and associated software. For example, the typical navigation device is likely to include one or more processors and software executable on those processors to carry out the operations described. We use the term software herein in its commonly understood sense to refer to programs or routines (subroutines, objects, plug-ins, etc.), as well as data, usable by a machine or processor. As is well known, computer programs generally comprise instructions that are stored in machine-readable or computer-readable storage media. Some embodiments of the present invention may include executable programs or instructions that are stored in machine-readable or computer-readable storage media, such as a digital memory. We do not imply that a "computer" in the conventional sense is required in any particular embodiment. For example, various processors, embedded or otherwise, may be used in equipment such as the components described herein.

Memory for storing software again is well known. In some embodiments, memory associated with a given processor may be stored in the same physical device as the processor ("on-board" memory); for example, RAM or FLASH memory disposed within an integrated circuit microprocessor or the like. In other examples, the memory comprises an independent device, such as an external disk drive, storage array, or portable FLASH key fob. In such cases, the memory becomes "associated" with the digital processor when the two are operatively coupled together, or in communication with each other, for example by an I/O port, network connection, etc. such that the processor can read a file stored on the memory. Associated memory may be "read only" by design (ROM) or by virtue of permission settings, or not. Other examples include but are not limited to WORM, EPROM, EEPROM, FLASH, etc. Those technologies often are implemented in solid state semiconductor devices. Other memories may comprise moving parts, such as a conventional rotating disk drive. All such memories are "machine readable" or "computer-readable" and may be used to store executable instructions for implementing the functions described herein.

A "software product" refers to a memory device in which a series of executable instructions are stored in a machine-readable form so that a suitable machine or processor, with appropriate access to the software product, can execute the instructions to carry out a process implemented by the instructions. Software products are sometimes used to distribute software. Any type of machine-readable memory, including without limitation those summarized above, may be used to make a software product. That said, it is also known that software can be distributed via electronic transmission ("download"), in which case there typically will be a corresponding software product at the transmitting end of the transmission, or the receiving end, or both.

Having described and illustrated the principles of the invention in a preferred embodiment thereof, it should be apparent that the invention may be modified in arrangement and detail without departing from such principles. We claim all modifications and variations coming within the spirit and scope of the following claims.

The invention claimed is:

1. A computer-implemented method for remotely controlling operation of a user application program executable in a motor vehicle, the method comprising the steps of:

providing a server computer located remotely from a motor vehicle and having access to wireless communications for exchanging information with the motor vehicle;

storing a digital configuration file in a datastore accessible to the server, the configuration file including predetermined parameters for remotely controlling a user application program's access to user interface resources of a head unit of the motor vehicle to extend a user interface of the application program to the head unit when the user application program is executed in the vehicle;

wherein the said predetermined parameters indicate, for a specified user application program, which user interface resources of a head unit the specified user application program is authorized to use, and conversely, which user interface resources of the head unit the specified user application program is not authorized to use;

and wherein the said predetermined parameters are specified as a function of the specified user application program, and are not associated with any specific user or operator of the motor vehicle;

receiving at the server a wirelessly transmitted request message from the motor vehicle, the request message

including an identifier of the motor vehicle, and data for identifying a user application program;

at the server, querying the stored configuration file to retrieve parameters stored in association with the user application program identified from the received request message;

forming a control message based on the retrieved parameters; and

wirelessly transmitting the control message to the motor vehicle in response to the request message, the control message indicating, for the identified user application program, which user interface resources of the head unit of the motor vehicle are permitted, or conversely are not permitted, to be utilized by the identified user application program to extend its interface, based on the parameters stored in the configuration file.

2. The method of claim **1**, and further comprising: including an identifier of the head unit in the request message; and wherein the control message is responsive at least in part to the identifier of the head unit.

3. The method of claim **1** including:

in the motor vehicle, establishing a communicative coupling between a user's mobile wireless device and the motor vehicle head unit; and

in the motor vehicle head unit, receiving data via the communicative coupling for identifying user application programs stored on the user's wireless device; and

wherein the data sent to the server in the request message for identifying a user application program includes data identifying at least one of the application programs stored on the user's wireless device, so that the control message indicates which user interface resources of the head unit of the motor vehicle are permitted, or conversely are not permitted, to be utilized by the identified user application program stored on the user's wireless device.

4. The method of claim **3**, wherein the user application program executes on the user's wireless device located in the motor vehicle and the communicative coupling to the head unit comprises a cable or short-range wireless link.

5. The method of claim **3**, wherein the user interface resources of the head unit subject to control via the control message include an audio output and a video display screen.

6. The method of claim **1**, wherein:

the request message includes an indication of a current status of the motor vehicle; and

the stored configuration file includes parameters for controlling usage of head unit resources based at least in part on the current status of the vehicle;

whereby the control message content is responsive to the current status of the vehicle.

7. The method of claim **6**, wherein the current status of the vehicle comprises an indication of whether or not the vehicle is moving.

8. The method of claim **6**, wherein the control message permits the user application program to access a display screen resource of the motor vehicle head unit user interface if the vehicle is not moving and disables access to the display screen resource if the vehicle is moving.

9. The method of claim **6**, wherein the vehicle status comprises an indication of whether or not a passenger seat is occupied and the stored configuration file includes parameters for controlling usage of head unit resources based at least in part on whether a passenger seat is occupied.

10. The method of claim **1**, wherein:

the head unit includes a display screen and the identifier of the head unit comprises one or more of a make/model/year of the vehicle, a predefined head unit identification code, and a listing of at least one parameter of the head unit display screen; and further comprising the steps of:

in the server, selecting a GUI based on information received in the request message; and

in the control message, instructing the head unit to install and use the selected GUI.

11. The method of claim **10** and further comprising: modifying the selected GUI in appearance based on a customized frontend selected based on a telephone number of a mobile device currently coupled to the motor vehicle head unit, or information provided by the user through the head unit.

12. A computer-implemented method for remotely controlling operation of a user application program in a motor vehicle, the method comprising the steps of:

providing a server computer located remotely from a motor vehicle and having access to wireless communications for exchanging information with the motor vehicle;

storing a digital configuration file in a datastore accessible to the server, the configuration file including parameters for remotely controlling access to user interface resources of a head unit of the motor vehicle, responsive to an identifier of a mobile wireless device, or information provided by the user through the head unit;

in the motor vehicle, establishing a communicative coupling by cable or wireless link between a user's mobile wireless device and the motor vehicle head unit;

acquiring a unique identifier from the mobile wireless device coupled to the motor vehicle head unit, or from the head unit provided by the user;

comparing the acquired unique identifier with the stored configuration file to determine parameters for remotely controlling access to user interface resources of the head unit of the motor vehicle, responsive to the unique identifier; and

wirelessly transmitting a control message to the motor vehicle, the control message indicating which user interface resources of the head unit of the motor vehicle are permitted, or conversely are not permitted, to be utilized by a user application program in the vehicle, based on the parameters stored in the configuration file;

receiving at the server a wirelessly transmitted request message from the motor vehicle, the request message including an identifier of the motor vehicle, identifier of the user, and an identifier of at least one user application program;

comparing the request message to configuration data stored at the server; and

wirelessly transmitting a control message from the server to the motor vehicle, the control message indicating which resources of the head unit of the motor vehicle are permitted, or conversely are not permitted, to be utilized by the identified user application program; and

responsive to the request message, wirelessly transmitting head unit frontend configuration data to the motor vehicle to deploy a selected user interface on the head unit, the selected user interface arranged for mapping a user interface of the identified user application program to the user interface of the head unit identified in the request message, for extending the user interface of the application program to the head unit.

13. The method of claim **12** wherein the selected user interface is previously stored as code in a memory accessible to the head unit.

14. The method of claim **12** including wirelessly transmitting the selected user interface from the server to the vehicle.

15. The method of claim 12 wherein:

the received request message includes an identifier of a current user of the motor vehicle;

the stored configuration file includes a corresponding profile for the current user; and

the control message to the vehicle is based in part on the corresponding user profile.

16. The method of claim 15 wherein the identifier of the current user comprises a unique identifier of a wireless device coupled to the head unit.

17. The method of claim 15 wherein selecting a particular graphical user interface for operation on the head unit is based on the identifier of the current user.

18. The method of claim 15 wherein the identifier of the current user comprises a telephone number of a wireless device coupled to the head unit.

* * * * *